WEST VIRGINIA
GEOLOGICAL SURVEY

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PLATE I.—Topography of the Pottsville Series and View of Cheat River, Looking South from Canyon Club House, near Mont Chateau, Monongalia County.

WEST VIRGINIA

GEOLOGICAL SURVEY

Marion, Monongalia and Taylor Counties.

By

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Assisted by

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I. C. WHITE, State Geologist.

WHEELING NEWS LITHO. CO.
WHEELING, W. VA.
1913

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J. LEWIS WILLIAMS.....*Stenographer*

LETTER OF TRANSMITTAL.

To His Excellency, Hon. Henry D. Hatfield, Governor of West Virginia, and President of the West Virginia Geological Survey Commission:

Sir: I have the honor to transmit herewith the Detailed Report and maps covering the counties of Monongalia, Marion and Taylor, prepared by Assistants Ray V. Hennen and D. B. Reger. This is one of the largest and most complete of any of the County Reports hitherto published, and needs only inspection to convey to the reader the vast amount of careful and painstaking labor expended upon the collection and assembling into orderly sequence the immense fund of information concerning the natural resources of the three counties in question.

That the authors have presented a most valuable treatise in the descriptions and maps of the area goes without saying in view of their previous work and publications. The district described is probably one of the richest in natural resources of any similar area in the entire Appalachian basin. This is true with reference to most any one of its numerous riches. In coal it occupies the heart of the Appalachian field, where the great Pittsburgh seam and the entire Monongahela series attain their greatest development, while in oil and gas production no corresponding areas are richer or contain a larger number of productive sands. Building stones, glass sands, brick and pottery clays abound, while the soils are of almost unbounded fertility wherever the measures above the Pittsburgh coal cover the surface with their self-fertilizing limestones and marly shales, so that not only the grasses, but all of the grains and fruits of the north-temperate zone find here a salubrious habitat for their best development. No finer cattle, sheep, hogs, horses, or poultry can be found than those born and bred within this area. In addition to the enormous supplies of coal, oil, and gas, nature has been especially prodigal of her gifts to this area in the vast hydro-electric power available on the two

great and rapid rivers which traverse portions of the area, viz., the Cheat and Tygarts Valley, which with the Monongahela will be able to furnish great quantities of light, heat, and power for untold ages after the vast supplies of the carbon fuels along their banks and tributaries have been exhausted.

The very complete structural maps of the three counties will prove of much aid in the development of the coal, oil, and gas resources. The soil maps and report of the U. S. Department of Agriculture, prepared by Messrs. Charles N. Mooney and W. J. Latimer of the Bureau of Soils, will prove of immense worth to agriculture, while the long lists of coal analyses by Messrs. Hite and Krak will be of great service to all interested in either the production or consumption of fuel.

I. C. White.

Morgantown, W. Va., September 1st, 1913.

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AUTHOR'S PREFACE.

As with other County Reports prepared by the writer and assistants, the most prominent geological features have been emphasized and an attempt has been made to so state the facts that they may be easily understood both by the residents of the area and State and the scientific world without conflicting with truth.

The report gives (1) a brief history of the counties and their development; (2) a study of their drainage systems and other surface features; (3) the geologic structure with a contour map of the Pittsburgh coal horizon; (4) eight chapters on their general geology and detailed stratigraphy with a map (see Map II) showing the outcrop of the different divisions of the rock column according to the generally accepted classification of American geologists; (5) a description of the oil and gas fields therein with suggestions for their future development, the same map referred to above showing the accurate location of the oil and gas wells and dry holes; (6) their minable coals, with a table showing the chemical composition, calorific value and fuel ratio and a final summary exhibiting the approximate available tonnage of coal in the three counties; (7) their clays, road materials, building stones, forests, and water-power; (8) a chapter on the soil and its products with suggestions for increasing the soil fertility; and (9) an appendix showing railroad levels therein.

As in other reports, special attention is called to the structure contours on Map II, whereon are shown the tidal elevation of the Pittsburg coal horizon at all points of the area. These contour lines, separated by 25 feet in elevation, except on the steep slope of the Chestnut Ridge anticline, where the contour interval is 100 feet, exhibit the approximate position of the horizon of this coal, the shape and location of the anticlines and synclines, and the direction of the *dip* and *strike* of the rock strata at any point, all of which is of great aid not only for the further development of the oil and gas pools therein, but also for the future mining of the several coal seams where the same are of workable dimensions, purity and regularity. Special attention is also called to the several areas outlined by the writer as "Prospective Oil and Gas Territory" by magisterial districts and page references in the Index under that heading.

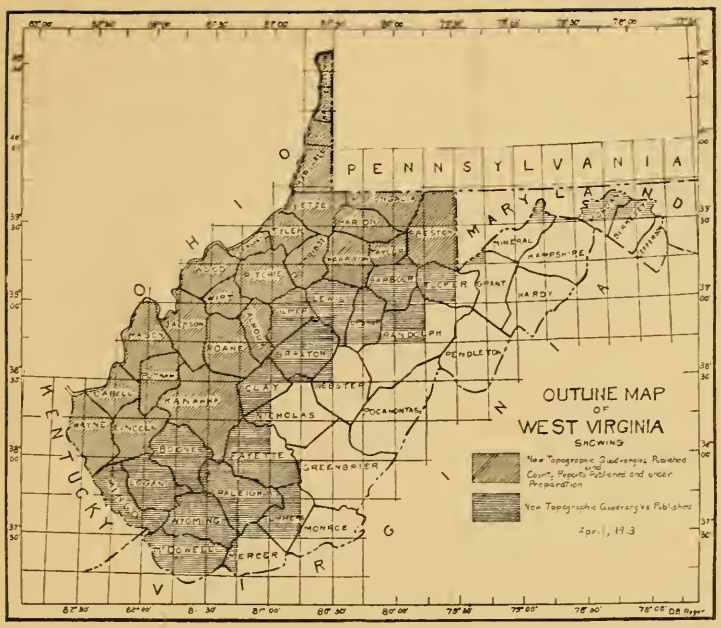

Figure 1.

Figure 1.—Map showing County Reports published and under preparation; also Topographic Quadrangle of 1-62500 Scale.

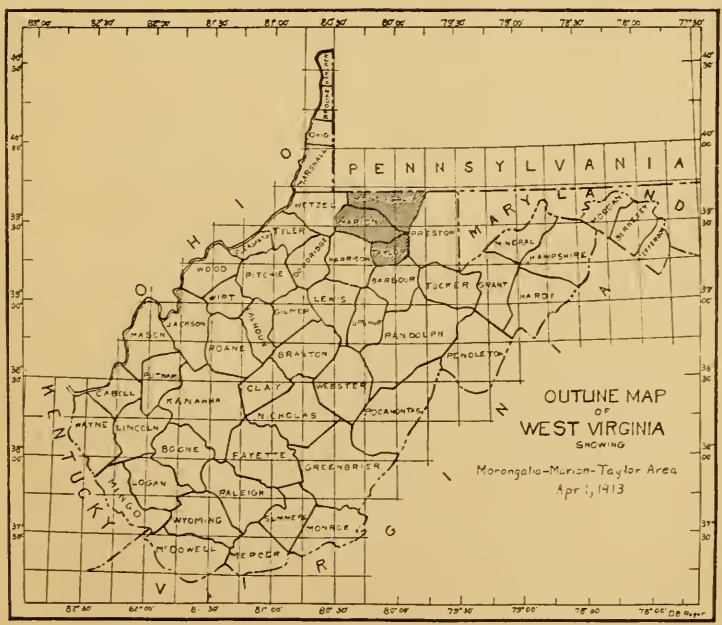

Figure 2.

Figure 2.—Map showing location of the Monongalia-Marion-Taylor Area.

Although quite technical, the chapters dealing with the general geology and detailed stratigraphy give a large fund of data concerning the formations of the Carboniferous group of rocks by series extending from the Dunkard down through the rock column to the base of the Pocono immediately overlying the Devonian System. Therein many errors of correlation in former State Reports are corrected, the writer ever keeping in mind the general and accepted classification of rock strata which permits comparison with the formations in other portions of West Virginia and in other States. Attention is called to the discussion and identifications of the Fossil Fauna of the Ames, Pine Creek and Brush Creek limestones by Dr. J. W. Beede of the University of Indiana.

The chapter on Coal gives the thickness, character and general distribution of the several minable beds, along with an approximate estimate of the available area and tonnage of eight different veins, with a final summary of the total available coal for the area. The commercial mines are referred to in the table of analyses by serial numbers, the same corresponding to numbers assigned to the sample designating the accurate location of the mine on Map II.

Chapter XIII gives a description of the clays, road materials, sands, building stones, iron ore, water power resources and forests. Special attention is called to the interesting paper on the water power resources by A. H. Horton, District Engineer, Water Resources Branch of the U. S. Geological Survey.

Charles N. Mooney and W. J. Latimer of the Bureau of Soils of the Department of Agriculture, Washington, D. C., prepared the final chapter on the soil and its products, which cannot fail to interest progressive farmers in the area.

Three maps of the entire area accompany this report in a separate cover, of which Map I shows by appropriate symbols the character of the surface, the roads, streams, railroads, etc.; Map II, by the same means, the general and economic geology with several items of special economic interest; and Map III in a similar way, the character, classification and distribution of the soils. In the body of this report these maps are frequently referred to by their Roman numerals, as Map I, Map II, or Map III.

The writer and his assistant, David B. Reger, spent the field season of 1911 and two or three short trips in 1912 gathering data for this volume. Mr. Reger also assisted both in the preparation of the manuscript of the report and the accompanying maps. He is the author of nearly all of Chapter VIII, all of Chapters IX and X, the major portion of Chapter XII, and all of Chapter XIII except the section on Water Power Resources. In order that uniformity of style might be preserved throughout the book he has referred to his own work by name, as was done by the writer in other chapters.

Much valuable aid and assistance were given by residents of the area and by officials of the several companies engaged in the development of the coal, oil, gas, clays and water power resources Due credit and acknowledgment have been given in the text for all such data published, except in the case of C. McC. Lemley, Resident Engineer of the B. & O. Railroad, who furnished some valuable photographs.

The chemical analyses and heat determinations were made in the Survey laboratory by J. Berghuis-Krak, Assistant Chemist, under the supervision of B. H. Hite, Chief Chemist.

As in former reports, the writer takes opportunity to express his obligations to I. C. White, State Geologist, whose writings and suggestions have added greatly to the value of the report.

RAY V. HENNEN.

Morgantown, W. Va., April 1, 1913.

ERRATA.

Page 76, "Part III" should read "Part II."

Page 402, Well No. 130 for "James L. Park" read, "Jos. L. Parks."

Page 448, for "John & W. L. Parks," read "Jos. & W. L. Parks."

Page 448, elevation of Well No. 127, instead of 1000′ B should be 1080′ B.

Page 449, elevation of Well No. 130 instead of 1080′ B should be 1000′ B.

Page 96, for "Grant Stephens," read "Grant Stevens."

Page 500, for "James Saunders," read James Sanders."

Page 410, for "D. M. Heard," read "D. M. Hoard."

Page 616, for "R. B. Coll," read "R. B. Gall."

Page 110, at top of section read 575′ instead of 1189′ for thickness. of Upper Carboniferous.

Page 633, for "Prunytown," read "Pruntytown."

Page 670, for "Mandedick Heirs," read "Mankedick Heirs."

Page 712, beginning sentence on 22nd line read, "With this information and with a planimeter determination of the area by Reger, the following estimate is made."

PART I.

History and Physiography.

CHAPTER I.

THE HISTORICAL AND INDUSTRIAL DEVELOPMENT.

LOCATION.

That part of West Virginia described in this report includes the area lying along and adjoining the southern boundary of Pennsylvania, near the southwest corner of the latter State, comprising the counties of Monongalia, Marion and Taylor, the whole lying between the parallels of 39° 14′ and 39° 44′ North latitude, and the meridians 79° 45′ and 80° 30′ West longitude from Greenwich. The three counties include an area of 859.5 square miles as follows: Monongalia, 368.8; Marion, 313.5; and Taylor, 177.2 square miles.

TRANSPORTATION.

Water Ways.

Monongahela River.—In the early days the Monongahela river and its tributary, Cheat river, were used to transport timber in log form to the accessible mills along their banks. The importance of the former stream as a means of transporting the coal from the great fields along its banks was early appreciated by the U. S. Government which has built a series of locks and dams—15 in number—along the same, making it navigable for large steamboats and barges from

Fairmont, W. Va., to Pittsburgh, Pa., a distance of 125 miles. Locks Nos. 9-15 inclusive are located in Monongalia and Marion counties, and the accurate location of each, along with its serial number, is given on Maps I, II and III. H. C. Newcomer, Lieut. Col., Corps of Engineers of the U. S. Engineer Office, Pittsburgh, Pa., has kindly furnished the Survey the data exhibited in the table on the next page. In addition to other items this table gives the distance in miles of each lock from the mouth of the river; the year of completion; the size of each lock; the tidal elevation of each pool; and the length of each dam accompanying the lock, and the material of which the dam was constructed.

For many years, Morgantown was the head of navigation on the Monongahela, but the completion of locks Nos. 10-15 inclusive in 1904, gives Fairmont that distinction.

Elements Locks and Dams Monongahela River.

Lock No.	Distance from Mouth. Miles.	When built.	LOCK. Size.	Lift Low Water.	Elevation Sills. Upper.	Elevation Sills. Lower.	Elevation Normal Pool.	Founded on	DAM. Length.	DAM. Material.	DAM. Founded on	ABUTMENT. Type.	ABUTMENT. Founded on
1	1.95	1909	56x360 56x362	4.4	698.6 G 698.4 M	693.0 G M	707.4	Rock.	962	Concrete on stone filled crib.	Rock and gravel.	Crib.	Gravel.
2	11.2	1904-6	56x362.5 56x362.5	7.85	707.1 G 706.6 M	699.25G 698.75M	715.25	Piles in gravel.	808.2	Concrete.	Piles in gravel.	Concrete vert. face.	Piles in gravel.
3	23.8	1905-7	56x360 56x360	8.65	714.75G M	706.75G M	723.9	Rock.	685.3	Concrete.	Piles in gravel.	Concrete vert. face.	Piles in gravel.
4	41.24	1840-4 1885-6	50x158 56x227	11.1	*726.18 x720.15M x723.74G	718.03 718.38	735.0	Gravel.	703	Timber stone filled.	Gravel.	Concrete sloped.	Gravel.
5	56.73	1908-10	56x360 56x360	12.1	738.6 G 738.1 M	726.6 G 726.1 M	747.1	Rock.	555.3	Concrete.	Piles in gravel.	Concrete sloped.	Rock.
6	68.67	1854-6	50x165	13.05	753.57G M	741.36G M	760.15	Rock.	626	Timber stone filled.	Rock and gravel.	Crib vert. face.	Gravel.
7	82.74	1882-3	50x159	9.2	763.99G 763.84M	754.19G M	769.99	Rock.	520	Timber stone filled.	Rock and gravel.	Masonry sloped.	Hard pan.
8	87.55	1882-9	50x161	10.6	775.0 G M	765.0 G M	780.8	Rock.	587.5	Timber stone filled.	Rock and gravel.	Masonry	Rock.
9	93.3	1874-9	50x160	12.35	787.0 G M	775.55G M	793.4	Rock.	388.7	Masonry.	Rock.	Masonry sloped.	Rock.
10	102.6	1898-03	56x182	10.66	797.66G 796.66M	787.0 G M	804.66	Rock.	444.3	Concrete.	Rock.	Concrete sloped.	Rock.
11	104.95	1898-03	56x182	10.67	808.33G 807.33M	797.67G M	815.33	Rock.	500	Concrete.	Rock.	Concrete sloped.	Rock.
12	109.85	1901-4	56x182	10.67	819.0 G 818.0 M	808.33G M	826.0	Rock.	425	Concrete.	Rock.	Timber vert. face.	Rock.
13	111.8	1901-4	56x182	10.67	829.67G 828.67M	819.0 G M	836.67	Rock.	410	Concrete.	Rock.	Concrete sloped.	Rock.
14	115.5	1902-4	56x182	10.67	840.33G 839.33M	829.67G M	847.33	Rock.	446	Concrete.	Rock.	Concrete sloped.	Rock.
15	124.1	1901-4	56x182	10.67	851.0 G 850.0 M	840.33G M	858.0	Rock.	430	Concrete.	Rock.	Masonry vert. face.	Rock.

* Large Lock. x Small Lock. G Guard Sill. M Miter Sill.

Steam Railroads.

Baltimore & Ohio Railroad—Main Line.—The main line of the Baltimore & Ohio R. R. extends entirely across Marion and Taylor counties in a northwest-southeast direction, a distance of 60 miles. This road was completed from Cumberland to Wheeling in 1852, and it is one of the main outlets for the immense coal tonnage of the three counties.

Baltimore & Ohio Railroad—Southwest.—This branch of the Baltimore & Ohio extends from Grafton westward, via Parkersburg, to St. Louis, Mo. It was completed from Grafton to Parkersburg in 1857, but only 13.8 miles is included in the area under discussion. This railway has a large freight traffic due to the development of the coal, oil and gas fields contiguous thereto.

Grafton & Belington Branch—Balt. & Ohio R. R.—This branch of the Baltimore & Ohio R. R. extends southeastward from Grafton along the east bank of Tygart river to Belington, a distance of 41.3 miles. From Grafton to the mouth of Sandy creek, where it leaves Taylor county, it is only 8.8 miles. This road was chartered in April, 1881, as the Grafton and Greenbrier Railroad, and was opened for use as a narraw gauge line between Grafton and Philippi in January, 1884. It was purchased by the Baltimore & Ohio in 1892 at foreclosure and was reorganized as the Grafton & Belington Railroad, being extended to Belington and converted to standard gauge May 1, 1892, according to C. W. Woolford, Secretary, Baltimore & Ohio R. R. Co. It has a large freight traffic in coal and lumber.

Monongahela River Branch—B. & O. R. R.—This branch of the Baltimore & Ohio System extends from Fairmont along the Monongahela and West Fork rivers to Clarksburg, a distance of 32.1 miles. Only 12.4 miles is included in the area under discussion, however. The road was built in 1890 by Hon. J. N. Camden, and sold in 1900 to its present owners It has a very heavy freight traffic from the several coal mines along both banks of the river.

Fairmont, Morgantown & Pittsburgh Branch—B. & O. R. R.—This branch of the Baltimore & Ohio was completed

from Fairmont to Morgantown February 1, 1886, and later (April 1, 1894) extended to Uniontown, Pa. It has a very heavy freight traffic, especially in coal. That portion included within Marion and Monongalia counties is 36.5 miles long.

Paw Paw Branch—B. & O. R. R.—This branch extends from Fairmont via Rivesville to the Federal mine of the New England Gas & Coke Co. on Paw Paw creek, a distance of 8.7 miles. Although it hauls a few passengers, it is mostly a coal carrying road.

Morgantown & Kingwood Railroad.—This railroad extends from Morgantown southeastward via Masontown, Kingwood and Rowlesburg to M. & K. Junction, in Preston county, for a total distance of 47.9 miles, 10.5 miles of which is included in Monongalia county. The road was completed from Morgantown to Bretz in September, 1903; Bretz to Kingwood in March, 1906; and Kingwood to M. & K. Junction in July, 1907. It has a heavy freight traffic in coal, building stone, glass sand and lumber.

Buckhannon & Northern Branch—Pittsburgh & Lake Erie R. R.—This road extends along the west bank of the Monongahela river from Fairmont to the W. Va.-Penna. State line where it connects with another branch of the same system to Brownsville, McKeesport and Pittsburgh. That portion of the road within the area under discussion—31 miles long—from Rivesville to the northern line of Monongalia county, built during 1911 and 1912, will open up a great coal field on the west side of the river in Marion and Monongalia counties.

Electric Railroads.

Monongahela Valley Traction Company—Fairmont & Clarksburg Branch.—This branch, completed in December, 1906, runs mostly along the west bank of the West Fork river between Fairmont and Clarksburg, leaving it only at two or three points to cut off long ox-bows in the latter stream. It has a very heavy passenger traffic due to the many coal mines along this valley between the two cities.

Fairmont & Mannington Railroad.—This trolley line is

controlled by the Monongahela Valley Traction Company and extends northwestward across the divide from Fairmont to Buffalo creek at Barrackville; thence, westward along the south bank of the latter stream to Mannington, a total distance of 17 miles. The road was completed during 1910, and it has a growing passenger traffic incident to the gradual development westward of the coal mining industry.

Monongahela Valley Traction Co.—Fairview Branch.—This branch was built during 1910, and extends from Fairmont to Fairview, Marion county, via Rivesville, a distance of about 16 miles. The road has a large passenger traffic, due to coal mines and oil and gas fields served by the same. It is a very important feeder to the Fairmont region, and furnishes an easy means for the farmers of northeastern Marion to reach the county seat.

Morgantown & Dunkard Valley Railroad.—This road extends from Morgantown to Cassville, a distance of about 8 miles. That portion from Morgantown to the mouth of Scott run at Randall was completed ready for operation on Sept. 10, 1910; and that from Randall up Scott run to Cassville, Nov. 30, 1911. It is the intention of the directors of this company to extend the line to Blacksville via Dolls run and Dunkard creek in the near future. At Blacksville it will connect with a line to be built from that point to Waynesburg, Greene county, Pennsylvania.

Highways.

In the early history of the three counties the subject of public highways was of great interest since they furnished the only means of communication with Baltimore and other eastern points. Later, the steam railroad caused a marked cessation of interest in public roads, but during the last five years, the advent of the automobile has awakened a new concern and engaged the attention of the State Legislature to the importance of maintaining good highways.

In his History of Monongalia County, pages 536-537, Samuel T. Wiley gives the following interesting account of the earliest roads in this area:

"The first roads in the county were little more than mere bridle paths. All record of the early roads up to 1796 is lost, and tradition offers little to supply its loss. The first road, it is said, was up Decker's creek, from the site of Morgantown to Rock Forge, and then ran with the site of the present road, known as the old Kingwood road, past the Dripping Spring. It was cut out, perhaps, between 1772 and 1776, and ran by the site of Kingwood (Preston county), crossed Cheat river at Dunkard Bottom, and ran to the site of Westernport (Md.), and then to Winchester. It was a pack-horse road. After the Revolutionary war, it became an emigrant road to the West, and on the 10th of December, 1791, an act of Assembly was passed for opening a road from the State road to the mouth of Fishing creek (New Martinsville). This old road was a part of the proposed road which, from Morgantown, ran with the present Fairmont turnpike to the 'Red Bridge'. From where the 'Red Bridge' now stands, it turned off and ran by the site of McCurdysville; thence beyond the county to Basnettville and on to the mouth of Fishing creek. It now became a wagon road. On Dec. 23, 1795, Wm. McCleery, Nicholas Cassey, Michael Kerns and Edward McCarty were appointed to repair that portion of it from Westernport to Morgantown, which was designated as 'a wagon road from the mouth of Savage river to Morgantown'. A lottery was authorized on Dec. 2, 1796, to raise money to repair this road from Morgantown to Winchester. The lottery scheme, however, was never carried out. The road was now called the old State road or the old Winchester road. In later years, after Kingwood was founded, that part from Morgantown to Kingwood was called the Kingwood road, and today (1883) is known as the old 'Kingwood road'."

Brandonville & Fishing Creek Turnpike.—This highway at present is only a dirt road, extending from the W. Va.-Md. line via Brandonville, Ice's Ferry bridge over Cheat river, and Morgantown to Fairmont. On pages 537 and 538 of the volume mentioned above, Wiley gives the following account of the early history of this road:

"The Brandonville and Fishing Creek Turnpike was agitated in 1830, and was projected in 1832, as the Maryland and Ohio Turnpike. In 1836, it received the first mentioned name. It ran from the Maryland line past Brandonville (Preston county), to Ice's Ferry; thence on the location of the present road from the ferry to Morgantown; thence on the location of the Fairmont Pike, on the west side of the river, to Fairmont, and on to the Ohio river at the mouth of Fishing creek. It was built between 1836 and 1839. In 1850 it was extensively repaired by Wm. J. Willey."

Morgantown & Kingwood Pike.—This highway is at present only a dirt road, extending southeastward from Morgantown along the dividing ridge between Aaron and Cobun creeks via Reedsville to Kingwood in Preston county. On pages 124 and 125, Wiley gives the following account of this road:

"The maximum limit of the capital stock of the Kingwood and West Union Turnpike Company was increased in 1851, and the extension of the road to Morgantown was also authorized. This road was constructed, and, between Morgantown and Kingwood, is familiarly known as the 'Morgantown and Kingwood Pike.' February 10th, the Board of Public Works was authorized to borrow $2,800.00 with which to macadamize this pike between Morgantown and Cranberry, which work was done. After the extension of the road to Morgantown, its name was changed to that of the Morgantown, Kingwood, and West Union Turnpike. This is now (1883) the best road in all this section of the country."

Morgantown & Bridgeport Turnpike.—This road, which is only a dirt highway, extends along the east side of the Monongahela river from Morgantown to Fairmont; thence via Watson, Boothsville and Bridgeport to Clarksburg. Concerning its early history, Wiley has the following to say on page 538:

"The next projected highway was the Morgantown and Clarksburg Turnpike, located by Col. Jas. Evans, from Clarksburg on the east side of the river, past Smithtown, to Morgantown, and then using the Brandonville & Fishing Creek Turnpike to Ice's Ferry; thence to the Pennsylvania State line. Nothing was done beyond the location. In 1849, the Morgantown and Bridgeport Turnpike was authorized by the General Assembly, and it was built in Monongalia on the location of the Morgantown and Clarksburg road from Smithtown, by Morgantown, to the Pennsylvania State line beyond Ice's Ferry, using a part of the road from Morgantown to Ice's Ferry."

That portion from Fairmont via Boothsville to Clarksburg is now familiarly known as the Fairmont and Bridgeport turnpike; and that, northward from the old Ice's Ferry to the W. Va.-Pa. State line, as the Uniontown pike.

Pennsylvania, Beverly & Morgantown Turnpike.—This road, which is also only a dirt highway, extends southeastward from Morgantown along the ridge between Cobun and Booths creeks via Ridgedale, Gladesville, Independence and Evansville to Beverly, Randolph county. Concerning its early history, Wiley gives the following on page 538:

"The Pennsylvania, Beverly and Morgantown Turnpike was incorporated in 1837; was revived in 1853; and was constructed from the State line, near Fort Martin church; crossed the Monongahela at Collin's Ferry, came by Morgantown, crossing the Morgantown and Bridgeport Pike, and ran to Evansville, Preston county, and on to Beverly. From Morgantown to Evansville this road is now (1883) generally called the Evansville Pike."

Beverly & Fairmont Turnpike.—This highway is also only a dirt road, extending from Fairmont southeastward via McGee and Fetterman to Grafton. According to Wiley, it was partly located in 1838 by Col. Jas. Evans, who located the road from a point three or four miles east of Fetterman northwestward via Fairmont and West Warren (Wadestown), and on towards Wheeling.

Dunkard Creek Turnpike.—This highway was never more than a dirt road. It extended northwestward from Morgantown up Scott run; thence down Dolls run and westward up Dunkard creek across the county. Wiley gives the following account of this road on page 539 of his History of Monongalia county:

"The Dunkard Creek Turnpike was projected in 1839, and revived in 1847. It was located by Col. Jas. Evans from Morgantown to Blacksville. A Dunkard Valley Turnpike Company was projected in 1871, to operate this road, which commences one mile west of Morgantown, and passes by Granville, Randall, Cassville, Brown's Mills, New Brownsville, Blacksville, and on to Burton, on the Baltimore & Ohio Railroad."

Northwestern Virginia Turnpike.—This highway crosses the southern portion of Taylor county in an east and west direction via Pruntytown, Grafton, Thornton, Evansville and Fellowsville. This is one of the best roads in the three counties, and also one of the oldest, since it was built between 1830 and 1836, having reached Clarksburg in the latter year. The writer has given a detailed description of this road on pages 4 and 5 of the Doddridge-Harrison report of the State Geological Survey.

Clarksburg & Weston Turnpike.—This is only a dirt highway, and extends southwestward from Fairmont in Marion county along the west side of West Fork river via Thoburn and Worthington.

According to Bulletins published for 1910 by Chas. P. Light, State Road Commissioner, the total mileage of all kinds of public roads for the area under discussion is as follows:

	Miles.
Monongalia County	800
Marion County	766
Taylor County	363
Total	1929

GENERAL DESCRIPTION.

MONONGALIA COUNTY.

Monongalia county is bounded on the north by the Mason & Dixon State line; on the east by Preston county; on the south by Taylor and Marion; and on the west by Marion and Wetzel counties.

Its area as determined by planimeter from the accurate topographic sheets of the U. S. Geological Survey, is as follows:

Districts.	Sq. Miles.
Battelle	56.40
Clay	63.49
Cass	34.71
Grant	46.61
Union	60.44
Morgan	39.88
Clinton	67.29
Total for county	368.82

According to Lewis[1], Monongalia county began its existence in October, 1776, by an act of the General Assembly of the newly-declared Commonwealth of Virginia, dividing the District of West Augusta into three distinct counties; viz., Monongalia, Ohio and Youghiogheny, and establishing the boundaries of Monongalia as follows:

"All that part of the said district[2] lying to the northward of the county of Augusta to the westward of the meridian of the fountain of the Potowmack, to the southward of the county of Yohogania and to the eastward of the county of Ohio, shall be one other distinct county, and shall be called and known by the name of Monongalia."

According to Henry Haymond in his History of Harrison County, page 158, additional territory was added to Monongalia county as follows:

"In October 1780 an Act was passed to the effect 'That all that part of the county of Augusta North West of the Line that divides Augusta from Green-Brier, on the top of the ridge, that divides the

1. V. A. Lewis, History of W. Va., page 506; 1889.
2. Referring to the District of West Augusta.—R. V. H.

waters of Green-Brier from those of Elk and Tygarts Valley, and with that ridge to the ridge that divides the waters of Potowmack from those of Cheat, and with the same to the line that divides Augusta and Rockingham, shall be and the same is hereby added to and made part of the county of Monongalia.'"

Thus Monongalia enjoys the distinction of being one among the first counties created under a republican form of government in America. It was intended to be named for the Monongahela river, which stream almost bisects the county as at present limited, but through a clerical error received the former appellation. Lewis adds the following about the creation of the county:

"The act creating the county further provided 'that it shall and may be lawful for the landholders of said county qualified to vote in the General Assembly to meet at the house of Jonathan Cobun, in said county, on the 8th day of December following, then and there to choose the most convenient place for holding courts for the county in the future.' In 1796 the records of Monongalia county were burned, and we have no means of ascertaining whether such an election was held. We may infer that it was, as thereafter the courts were regularly convened at the plantation of Theophilus Phillips, near where New Geneva, Fayette county, Pennsylvania, now is, the last-named county at that time being a part of Monongalia. Nor can it be stated with certainty who was the first sheriff and clerk of the county. In Monongalia, tradition names Captain John Dent as the first sheriff and Colonel John Evans as the first county clerk, while a Fayette county tradition makes Joseph Coombs the first clerk."

Monongalia as now limited occupies only a small portion —slightly over 7 per cent—of the original area called for in the act of the Virginia General Assembly creating the county in 1776, which included practically the entire drainage basin of the Monongahela river above Brownsville, Penna., covering the southeast corner of Washington county, the eastern portion of Greene and the southwest portion of Fayette, in Pennsylvania; and in West Virginia, all of the present area of Monongalia, Preston, Marion, Harrison, Taylor, Barbour, the western half of Tucker, all of Randolph except a small strip along the southeast border, all of Upshur except a small strip along the southwest edge, and the eastern two-thirds of Lewis; the whole covering an area approximating 5000 square miles.

The general surface of the county varies in elevation from 793.4 feet above tide—Pool No. 9 level of the Monongahela river at Morgantown—to 2600 feet above tide near the summit

of a high knob on Chestnut Ridge in the extreme northeast corner of the county, a range in elevation of slightly over 1800 feet.

Population.—In 1900 the population was 19,049, of which 18,747 were white; 299, colored; and 301, foreign born. The census of 1910 gives the total population as 24,334, a gain of 5,285, or an increase of 27.74 per cent. As appears on a subsequent page, this growth in population in the last ten years has mostly taken place in the City of Morgantown, located in Morgan district, and in Westover on the opposite side of the river, in Grant district, the five other magisterial districts having lost in population during the last decade. This marked decrease in the rural portions of the county illustrates the country-wide tendency of the younger generation to leave the farms for the seemingly more attractive life of urban regions. During the last three or four years, however, the high cost of living in cities and towns has awakened a new interest in agriculture, and started a "back-to-the-farm" movement here as well as elsewhere.

The following table shows the changes in population in Monongalia county by magisterial districts during the last 20 years, as determined by the Census Bureau at Washington, D. C.:

Districts—Monongalia County.	Population.		
	1910	1900	1890
Battelle	2270	2760	2452
Clay, including Blacksville town	2797	3149	2827
Cass	1173	1444	1495
Grant	2495	2152	2118
Union	1553	1637	1488
Morgan, including Morgantown and Star City	11631	5356	2973
Clinton	2415	2551	2352
Totals for county	24334	19049	15705

The principal farm products of Monongalia are corn, wheat, oats, hay, potatoes, garden vegetables, apples, dairy products, beef cattle, sheep and poultry. A full discussion of

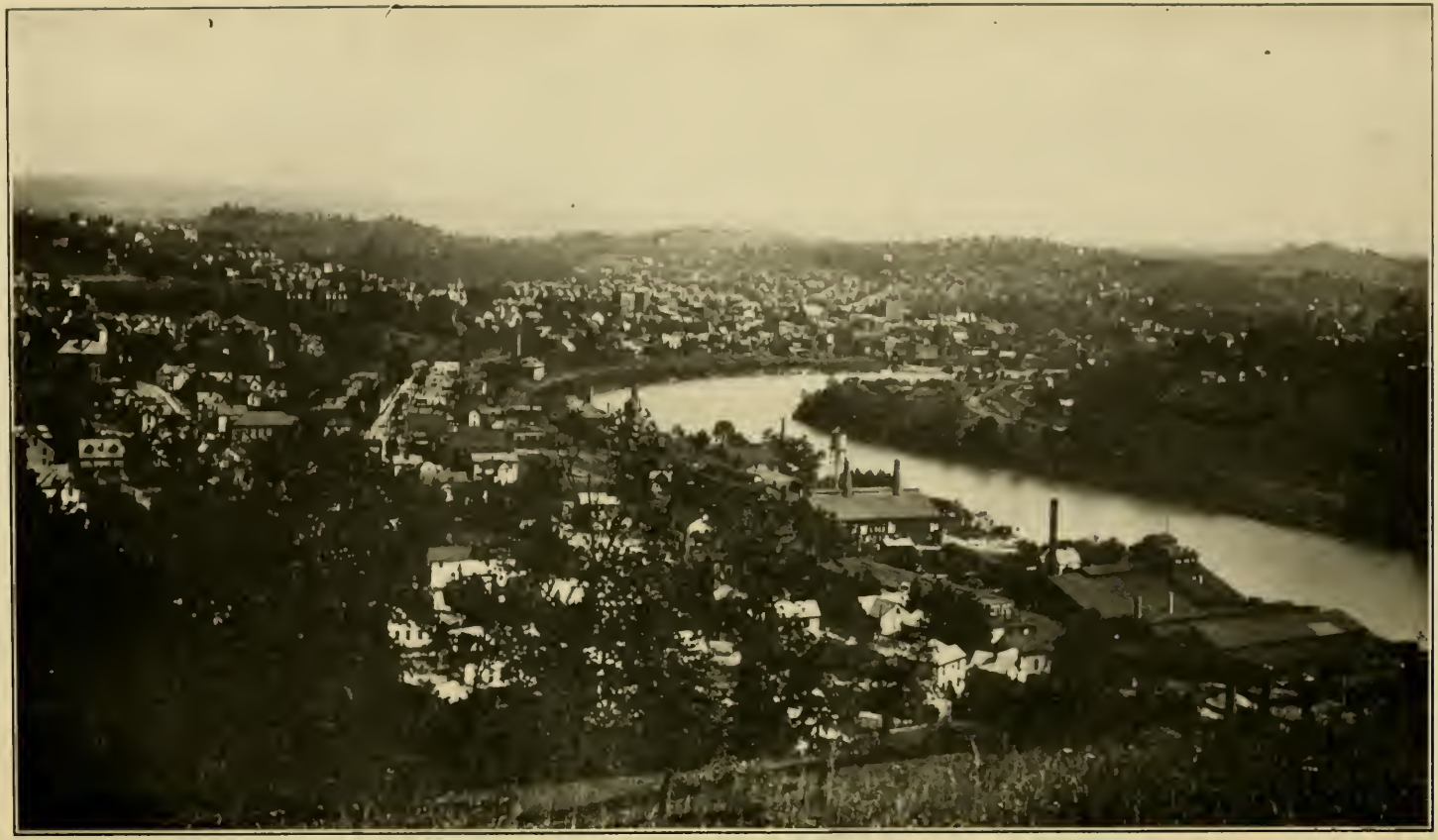

PLATE II.—View of Morgantown, Showing Topography of the Conemaugh Series, with the Allegheny and Pottsville in Chestnut Ridge on skyline.

the character and classification of the soils therein is given in a subsequent chapter on Soils.

The principal mineral and manufactured products are coal, petroleum, natural gas, coke, building stone, glass sand, foundry products, lumber, glass ware, tin plate and brick.

The State Auditor gives the following assessed property valuations for Monongalia county for the years 1910, 1911 and 1912:

	1910	1911	1912
Real Estate	$29,141 518	$30,467,055	$31,160,345
Personal Property	8,909,075	8,903,178	9,059,786
Totals	$38,050,593	$39,370,233	$40 220,131

The above ranks Monongalia fifth and next to Kanawha in point of wealth among the counties of the State.

A brief description of the incorporated cities and towns will now be given.

Morgantown.

Morgantown, the county seat of Monongalia, is the largest and most important town in the county. It is located a few miles east of the central portion of the county on the east bank of the Monongahela river, at the mouth of Deckers creek, being largely built on high terraces, or old erosion levels of these two streams, 100 to 150 feet above the river. The first white man to settle at the site of Morgantown was Thos. Decker, concerning whom Wiley gives the following in his History of Monongalia County, pages 570 to 572:

"'In the fall of 1758, Thomas Decker and some others commenced a settlement on the Monongahela river at the mouth of what is now Decker's creek.' This account would make their settlement on the site of Morgantown. A tradition, current among old people, makes Decker, escaping from the massacre of his colony by Indians, in 1759, to jump into a rattlesnake den, where he was bitten to death, and locates the affair at the Harner place, some miles up Decker's creek.

"Frontier history and tradition agree in making David and Zackwell Morgan, the next settlers after the Deckers, on the site of Morgantown, in 1768, and the first owners; but Survey Book No. 1 in the Court House makes Isaac Lemasters the first owner, settling in 1772, and selling to Zackwell Morgan the site of Morgantown.

"Zackwell Morgan, supposed to be a relative of Gen. Daniel Morgan, was here in 1766, by Colonel Crawford's sworn statement.

Wither's Border Warfare makes David Morgan to have come in 1768, and also Zackwell. The tradition in the Morgan family makes David to have come first, and Zackwell, his brother, to have followed in 1772 or 1773, when David Morgan left Zackwell in possession of the place and removed to the vicinity of Prickett's Fort (Marion county), where, when sixty years of age, he had his celebrated fight with the Indians. * * * *

"Zackwell Morgan was of Welsh descent, came from Berkeley county, Virginia, settled for a time on George's creek in Pennsylvania, and then came to the site of Morgantown."

On pages 515 and 516 of the same reference, Wiley adds the following:

"The General Assembly, in October, 1785, established Morgans-Town by an act reading as follows:

"'Be it enacted by the General Assembly that fifty acres of land, the property of Zackquell Morgan, lying in the county of Monongalia shall be, and they are hereby, vested in Samuel Hanway, John Evans, David Scott, Michael Kerns and James Daugherty, gentlemen, trustees, to be by them or any three of them laid out in lots of half an acre each with convenient streets, which shall be, and the same are hereby, established a town by the name of Morganstown.'*******

"Morgantown was incorporated on the 3rd day of February, 1838, as 'The Borough of Morgantown,' and seven trustees, to be elected annually, were to administer its municipal affairs. March 20, 1860, an amended charter was secured from the Legislature of Virginia, providing for the election of a mayor, sergeant, five councilmen and a recorder. The boundaries of the borough were declared to be as follows: 'Beginning at the mouth of Deckers creek and running down the Monongahela river with its meanders 96 poles, to where a Spanish oak and sugar tree (stood), the lower corner of Morgan's survey; thence with a line of the same, N 77½°, E 48½ poles to where a black oak stands, now in the North Boundary street; thence along said street S 57½° E 92 poles, crossing the Deep Hollow run to said Morgan's line, and with same S 35½° W 4⅘ poles to a white oak, his corner, and corner to Michael Kern's; and with their lines S 89° 7' W 31 poles to a white oak on a point; S 15° W 16 poles to the mouth of the aforesaid Deep Hollow run at a high rock; thence down Deckers creek with its meanders, and binding therewith, 200 poles to the beginning.'"

In 1901 Morgantown was incorporated as a city and annexed the towns of Seneca, Greenmont and South Morgantown. During the last 10 years it has enjoyed a very rapid growth both in population and in industrial activity. In 1900 the population was only 1895, but the census of 1910 gives it 9,150, a gain of 7,255, or an increase of 382.8 per cent, leading all other towns in the State in that respect. The high rate of gain is due in part to the annexation of the three suburban towns mentioned above in 1901. In order of population it is now the ninth city of the State, ranking next to Clarksburg.

PLATE III.—The Circle, West Virginia University, at Morgantown.

West Virginia University.—The State University is situated within the corporate limits of Morgantown. The buildings, thirteen in number, are all located, with the exception of the Central Heating Plant, on a high terrace or old erosion level of the Monongahela river, 140 to 200 feet above the level of the latter stream. The following account of the University is given on page 221 of Vol. I of the W. Va. State Board of Control, published under date, September 30, 1910:

"**History.**—The University is, of course, the chief of all the educational institutions of the State. It was established in 1867, and received at once the benefit of the Land Grand Act, so-called, passed by Congress in 1862. The lands so received were sold for $90,000.00, which with small additions constitute the present endowment fund of about $115,000.00. The first faculty consisted of six members. That number has now grown to about seventy-five. There were originally three departments—classical, scientific, and preparatory—including about seventy courses of instruction. There are now more than forty departments, schools and colleges, and between five and six hundred courses of instruction.

"**Location and Organization.**—The University is located within the corporate bounds of the city of Morgantown, Monongalia county. Its campus is beautifully situated on the right bank of the Monongahela river along three different elevations to a maximum height of about three hundred feet above the level of the river bed. It includes about fifty acres. The State Farm, nearby, used by the Experiment Station, is a tract of nearly a hundred acres.

"The organization of the University embraces: the college of arts and sciences, including the department of military science; the college of engineering and mechanic arts; the college of agriculture; the college of law; the college of medicine. The following schools are connected with the University: the school of music; the school of fine arts; the summer school; the preparatory school. The Agricultural Experiment Station, supported in the main by the United States Government, is a department of the Universiy. * * *

"**Equipment.**—The equipment of the University consists of thirty-one laboratories in use by the departments needing them, and of furniture, apparatus, and special facilities for instruction distributed among all the departments. In this distribution the following may be specially mentioned: Libraries, including about 40,000 volumes; laboratories for chemistry, geology, botany, bacteriology, physics, anatomy, physiology, histology, pathology, zoology and horticulture; shops for civil, mechanical, electrical, and mining engineering; special plants for such departments as agriculture, physical training, history, mathematics, commerce, fine arts, and veterinary science; equipment for the Experiment Station, and the State Farm, including apparatus, stock, and farm implements."

The following tables, taken from pages 47 and 48 of Vol. II, Part II, show the attendance in the several colleges and schools and the distribution of this attendance among the various departments for the years 1910-11 and 1911-12:

Enrollment for 1910-1911.

The Colleges.

	Candidates for Degrees.								Candidates for Diplomas			Special			Total.		
	Grad.	Sen.	Jun.	Soph.	Fresh.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.
Arts and Sciences.	18	39	45	45	97	149	95	244	..	..	..	6	5	11	155	100	255
Engineering	..	19	14	13	32	78	..	78	..	..	..	3	..	3	81	...	81
Agriculture	..	3	4	4	4	15	..	15	..	..	..	2	..	2	17	...	17
Law	..	5	15	20	5	45	..	45	4	..	4	25	..	25	74	...	74
Medicine	..	1	3	7	6	17	..	17	..	..	..	..	..	..	17	...	17
Total	18	67	81	89	144	304	95	399	4	..	4	36	5	41	344	100	444

The Schools.

The School of Fine Arts	...	9	9
The School of Music	6	52	58
The Commercial School	1	16	19
The Summer School	67	204	271
The Preparatory School	79	21	108
The School of Agriculture	11	...	11
Total	164	304	468
Irregular Students in Music	9	72	81
Music	...	8	8
Art	...	65	65
Physical Training	54	7	61
Short Course in Agriculture	20	19	39
School of Sunday School Methods	4	11	15
Total	87	182	269
Entire enrollment at Morgantown	251	486	737
Additional enrollment in Agricultural Extension Schools	...	...	245
Grand Total			982

Enrollment for 1911-1912.

The Colleges.

	Candidates for Degrees.								Special			Total.		
	Grad.	Sen.	Jun.	Soph.	Fresh.	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Female.	Total.
Arts and Sciences...	16	45	36	56	126	177	102	279	10	4	14	187	106	293
Engineering	..	17	11	20	36	84	...	84	3	..	3	87	...	87
Agriculture	2	6	5	8	15	36	...	36	..	..	..	36	...	36
Law	1	14*	14*	21*	...	50	...	50	13	..	13	63	...	63
Total.....	19	82	66	105	177	347	102	449	26	4	30	373	106	479

The Schools.

The School of Music.....	6	107	113
The Preparatory School.....	48	14	62
The School of Fine Arts.....	1	14	15
The School of Agriculture and Home Economics.....	19	3	22
The Summer School.....	77	206	283
The School of Methods for Sunday School Workers.....	3	16	19
The Farmers Course.....	40	...	40
The Winter Course in Home Economics.....	...	35	35
The Night Classes.....	12	13	25
Total.....	206	408	614
Entire Enrollment at Morgantown.....	579	514	1093
Additional Enrollment in Agricultural Extension Schools.	265	167	432
Grand Total.....	844	681	1525

*Students in the College of Law are known as Third-year, Second-year, and First-year Students.

Glass Industries.—Morgantown is the leading glass manufacturing town in the State. Nine different plants are situated within the corporate limits, or in the vicinity thereof. All the concerns have located there during the last 16 years, having been attracted by the low price of natural gas offered for manufacturing purposes. A brief account will now be given of each plant from data collected by Mr. Reger:

Seneca Glass Company, Factory A.—This plant and its main office are located near the Baltimore & Ohio R. R. in the Fourth Ward. It was the first glass factory in Morgan-

town. According to C. F. Boehler, Secretary and Treasurer of the Company, the plant was established in 1896. The articles manufactured are lead blown bar and table ware, and the capacity of the concern is two to three carloads weekly. No machines are used, all ware being hand blown. Sand from Berkeley Springs, W. Va., and Hancock, Md., is used. It is a 14-pot factory, furnishing employment for 250 persons—150 men, 50 boys and 50 girls—100 of whom are skilled workers. The pay roll averages $10,000 to $12,000 monthly, and the plant operates during the entire year.

Seneca Glass Company, Factory B.—This plant is owned by the same company, and is located in Star City, 2 miles below the corporation line of Morgantown. The factory first started to operate in August, 1911, and makes lime blown tumblers. It has two 6-ring tanks, only one of which was in operation in March, 1912. Employment is furnished under these conditions for 80 persons, but the latter figure will be increased to 200 when it is in full operation. All ware is hand blown, no machines being used. The sand utilized is obtained from the same source as that for Factory A, given above, and the lime from Martinsburg, W. Va., and Toledo, Ohio.

W. R. Jones Glass Company.—The W. R. Jones Glass Company plant and head office are located along the Baltimore & Ohio R. R. in the Fourth Ward. According to Chas. Palmer, Supt., it was established in 1901, and manufactured up to 1912 hand blown window glass exclusively. The capacity of the plant is 25,000 boxes monthly. The sand utilized is obtained from the Sturgisson quarry in the Upper Connoquenessing sandstone of the Pottsville series, on Deckers creek, Monongalia county, 5½ miles southeast of Morgantown; and the lime, from Martinsburg, W. Va. Employment is furnished for 250 men, 175 of whom are skilled workmen. The pay roll is $250,000 yearly. This factory operates only ten months in the year, generally shutting down during the hot months of July and August.

During 1912 the plant changed from hand to machine blown ware by the installation of Jones Machinery & Glass Company machines. Under these new conditions the capacity

is 1000 boxes daily; the number of employees, 200, of which 100 are skilled; and the pay roll about the same as before.

Marilla Window Glass Company.—This plant is located along the Morgantown & Kingwood Railroad on the east side of the "Peninsula" in the 2nd Ward. The main office is also in Morgantown. According to H. A. Limpert, Manager, and J. L. Keener, President, it was established in 1902, and up to 1912 manufactured hand blown window glass exclusively. The capacity of the plant is 150,000 square feet, or 3,000 boxes weekly. The sand utilized is obtained from the Sturgisson quarry mentioned above, and the lime from Martinsburg, W. Va. Employment is furnished for 250 men, 150 of whom are skilled workmen. The pay roll averages $12,000 to $15,000 monthly. When running at full capacity, 700,000 to 800,000 cubic feet of natural gas is consumed daily. The plant operates only 8 months of the year, shutting down during the hot months to renew the tank lining.

During 1912 this plant also changed from hand to machine blown ware by the installation of 6 Jones Machinery & Glass Company machines of 5 blowers each. Under these new conditions, the capacity is 200,000 boxes yearly; number of employes, 200, of which 60 are skilled; and the pay roll, $100,000 yearly.

Mississippi Glass Company.—The plant of this company is located in the First Ward along the Baltimore & Ohio Railroad, near the southwest edge of Morgantown. The principal office of the company is in New York City. According to H. L. Carspecken, Manager, the plant was established in 1902. It manufactures wired, figured and skylight glass, having a daily capacity of 40 tons. The sand utilized comes from Berkeley Springs, Morgan county, and the Sturgisson quarry in Monongalia county; and the lime from Martinsburg, Berkeley county. Employment is furnished for 175 persons, mostly men, about one-half of whom are skilled workmen. The glass is machine rolled. The pay roll is $150,000 yearly.

Pressed Prism Plate Glass Company, Sabraton Works.—This plant is located along the Morgantown & Kingwood R. R., three-fourths mile southeast of Morgantown. The main office is in Chicago, Illinois. According to M. A. Ross,

Asst. Manager, the factory was established in 1903, and it manufactures plate glass specialties, ornamental plate, prism plate, and also some rough plate, having a daily capacity of 5,000 square feet. It has two continuous tank furnaces, five plate glass grinding and polishing machines, and special casting machinery patented by this firm, not used elsewhere. The sand utilized comes from the Sturgisson quarry; the lime, from Tiffin, Ohio; the soda, from Barberton, Ohio; the nitre, from Chile; the manganese, from Saxony; and the powdered emory for grinding purposes, from North Grafton, Mass. Employment is furnished for 100 men, 10 of whom are skilled workmen. The pay roll is $5,000 monthly. The plant runs during the entire year. Natural gas is used for fuel, of which one-half million cubic feet is required daily.

Star Glass Company.—This plant is located 2 miles northwest of Morgantown at Star City, at which place is also located its main office. According to W. J. Wambaugh, Sec. and Treas. for the company, the factory was established in December, 1904, and it manufactures lamp chimneys, gas globes and electric shades. All ware is hand blown. The capacity is five carloads weekly. The equipment includes three day tanks which are about equivalent to a 12-pot furnace. The sand utilized comes from Berkeley Springs, Morgan county; and the lime, from Huntington, Indiana. Employment is furnished for 180 persons—135 men, 20 women and 25 boys—100 of whom are skilled workers. The pay roll is $2,500 weekly. The plant is in operation 10½ months of the year, generally from August 15th to July 1st.

Union Stopper Company.—The plant and head office of this company are located along the Baltimore & Ohio R. R. in the Fourth Ward of Morgantown. According to P. J. Beaumont, Gen'l Manager, this factory was established in 1905, and it manufactures a general line of glass ware such as table ware, stationer's goods, and electric lighting glass ware. All ware, lime glass, hand blown and pressed. The output is about $150,000 worth annually. The equipment includes a 14-pot furnace. The sand utilized comes from Berkeley Springs, Morgan county; the lime, from Tiffin, Ohio; and the soda ash, from Détroit, Mich. Employment is fur-

nished for 175 persons—50 per cent men; 30 per cent boys; and 20 per cent girls—40 per cent of whom are skilled workers. The average pay roll is $6,400 monthly. The plant runs 11 to 12 months of the year.

Economy Tumbler Company.—This plant and its head office are located along the Baltimore & Ohio R. R. in the Fourth Ward of Morgantown. According to W. E. Hunter, President and Manager, the factory was established in 1906, and it manufactures table glass ware, having an output of $400,000 worth annually. All ware is hand blown. The equipment includes a 24-pot furnace. The sand utilized comes from Berkeley Springs, Morgan county; and the lime, from Huntington, Indiana. Employment is furnished for 400 persons—50 per cent, men; 15 per cent, boys; and 35 per cent, women—of whom all but about 5 per cent are skilled workers The plant is in operation generally 50 weeks during the year. The pay roll for the year 1911 was $245,000 exclusive of the salaries of the officers.

Crystal Tumbler Company.—This plant and main office are located along the Baltimore & Ohio R. R. in the Fourth Ward of Morgantown. According to E. B. Stone, Sec. and Treas., this company was incorporated March 14, 1910, and operations begun in August, 1911. It manufactures lime flint glass tumblers, pitchers, bar ware, etc. The output is 75 barrels daily, but when running at full capacity, 125 barrels. All ware is hand blown. The equipment includes an 8-ring continuous tank. The sand utilized comes from Berkeley Springs, Morgan county; and the lime, from the States of Ohio and Indiana. Employment is furnished for 200 persons —125 men, 25 boys, 50 women—150 of whom are skilled workers. The monthly pay roll is $7,000, and the shipments for March, 1911, amounted to $11,600. The plant expects to operate 50 weeks during the year.

S. R. Wightman Glass Company.—This plant is located along the Morgantown & Kingwood R. R. on Deckers creek, one-half mile southeastward from the corporation line of Morgantown. It started in December, 1905, but owing to financial difficulties, it was compelled to shut down in May, 1910, and has not since resumed operations. It is now owned

by the Farmers & Merchants Bank of Morgantown. The buildings and grounds were purchased by the Wightman interests from the West Virginia Bottle and Glass Company. It manufactured glass bottles exclusively. The "Industrial Edition" of the New Dominion, Morgantown, W. Va., edited and compiled by Chas. J. Holmes, under date, May, 1906, gives the equipment and other data of this factory as follows:

"There are three bottle machines running two shifts per day, and each machine has a capacity of four carloads per week, making a weekly output of twelve cars. There are three lehrs and six shops. There are three men and three boys employed on each shop, and the shops average twenty gross to the shift. There are two shifts for each day of the week, and the amount of material that is turned out is enormous. At the Sabraton plant there are two tanks, but at the present time but one of them is in operation. The second tank is being overhauled and it will be placed in operation at no great distance in the future. With one tank running, there are 150 men employed and this number will be increased to 300 when both tanks are running full."

Miscellaneous Industries.—In addition to the glass industry, there are several other important factories in Morgantown that deserve special mention. A brief account will now be given of these from data collected by Mr. Reger:

American Sheet & Tin Plate Company—Sabraton Works

This plant is located along the Morgantown & Kingwood R. R. on Deckers creek, one mile southeastward from the corporation line. The stock of this company is held by the United States Steel Corporation. According to W. C. Loyd, Manager of the Sabraton Works, the latter was established in 1905, and it manufactures tin and terne plate. It is a ten-mill plant, having a weekly output of 900 tons. Employment is furnished for 750 persons, 40 to 50 of whom are girls. With the exception of 50 employes, all labor is skilled or semi-skilled. The plant operates the year round, and the pay roll averages $60,000 monthly. Natural gas is largely used for fuel, the consumption of which reaches 65,000,000 cubic feet monthly, the same being furnished by the West Virginia Traction and Electric Company of Morgantown, at the rate of 6 cents a thousand cubic feet in summer months and 8 cents in winter months.

Chrisman & Goodwin Foundry.—This plant is located

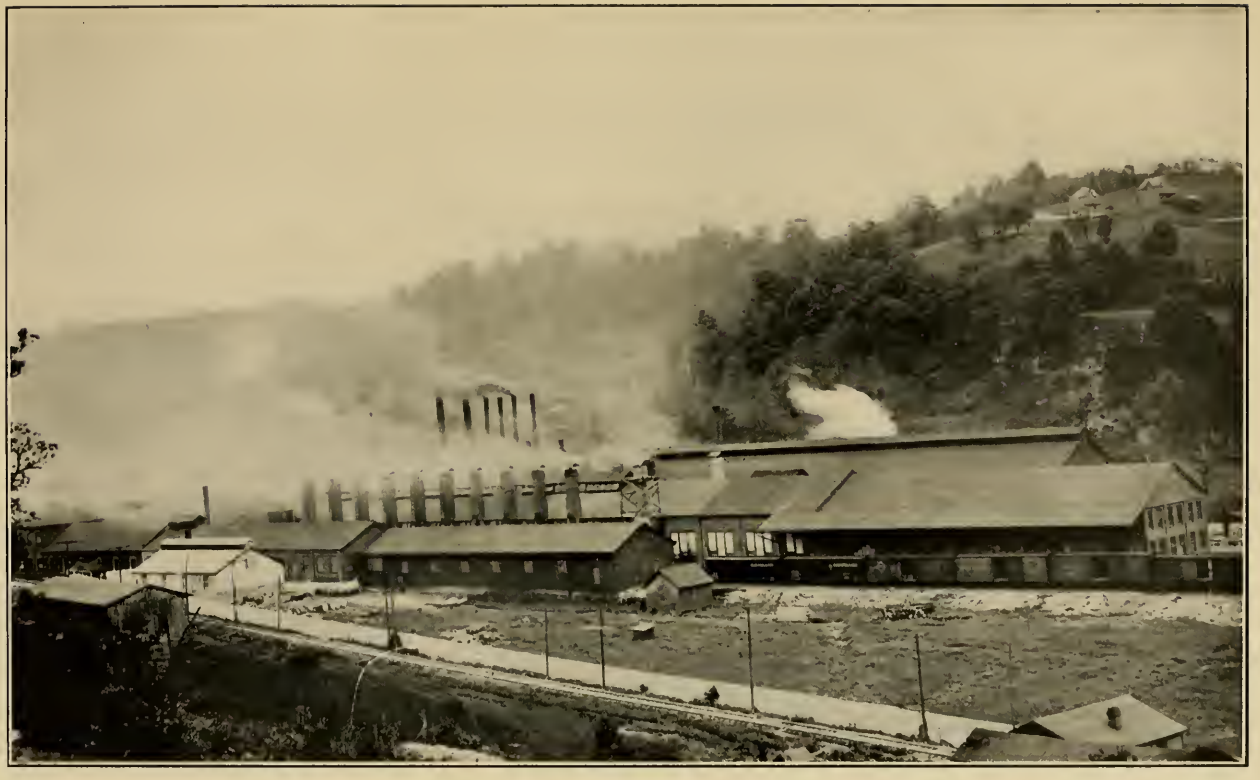

PLATE IV.—Sabraton Works, American Sheet & Tinplate Company, Sabraton, Monongalia County.

in the First Ward along the Baltimore & Ohio R. R., and is operated by Robt. R. Chrisman and Geo. R. Goodwin, both of Morgantown. According to Mr. Chrisman, the factory was established Nov. 1st, 1909. It manufactures gray iron and brass castings on special orders, doing jobbing work only. The capacity of the plant is 7 tons daily. Employment is furnished for 16 men, 12 of whom are skilled workmen. The sand utilized for moulding purposes comes from an old river terrace deposit on the Reed farm near Star City, Monongalia county. It runs the year round, and has a monthly pay roll of $1,500. The value of the yearly output is $40,000. The company has recently acquired a new site on the west side of the Monongahela, opposite Morgantown, and will erect in the near future a much larger plant fronting both on the river and Buckhannon and Northern Railway (P. & L. E.)

Lough Bros. Carriage Factory.—This plant is located in the Fourth Ward of Morgantown. According to data given by J. M. Lough, the factory was established in 1891. It manufactures wagons, carriages and drays, having an output of 40 to 50 yearly. Employment is furnished for 5 persons, all of whom are skilled workmen.

Morgantown Brick Company.—This company has two plants one of which is located in the Fourth Ward of Morgantown, and the other on the opposite side of the river. The former is the only one in operation at this time, and it makes paving brick exclusively. According to S. S. Minor, Superintendent, employment is furnished for 35 to 40 men, and the monthly pay roll ranges from $1,700 to $1,900. A further description of this plant is given in the chapter on Clays.

Westover.

Westover is another important suburb of Morgantown, located opposite on the west side of the Monongahela river. It was incorporated as the City of Westover on October 12, 1911. An enumeration, taken August 18, 1911, gives the population as 521. The city as limited by the corporate lines fronts on the river for about a mile, and includes a boundary

of 287.11 acres. The Buckhannon & Northern Branch of the Pittsburgh & Lake Erie R. R. passes through it from Fairmont to Pittsburgh. It is connected with Morgantown by the new highway bridge over the Monongahela, and two separate trolley lines.

Riverside.

Riverside fronts on the west side of the Monongahela river and extends from the western boundary of Westover westward to Dents run, including within its corporate limits 202.4 acres. It was incorporated as the Town of Riverside on April 6, 1912; the census figures accompanying the papers of incorporation, dated February 27, 1912, give the population therein as 182, and the number of legal voters as 61. It is connected with Morgantown by two trolley lines and the B. & N. R. R.

Star City.

Star City is located on the east bank of the Monongahela river, opposite the mouth of Scott run, 2 miles northwest of Morgantown. It was incorporated May 17, 1907, as the Town of Star City, and includes a boundary of 291 acres. The census of 1910 gives its population as 318. Almost its entire growth has taken place since 1900. It is largely populated by glass workers, since two of the glass plants described on preceding pages are located here.

Blacksville.

Blacksville, the largest town of Clay district, Monongalia county, is located on the north bank of Dunkard creek near the northwest corner of the district. It was incorporated as the Town of Blacksville by an act of the General Assembly of Virginia, passed on February 3, 1830. A plat of the town as laid out by David Black, from whom the village was named, is recorded on page 312 of Deed Book No. 11, Old Series, in the Office of the County Clerk at Morgantown. In 1900 its population was 180, but the census of 1910 gives it 204.

In addition to the above described incorporated towns for Monongalia county, the following is a list of villages therein, the most of which are merely cross-road towns with one or more stores and a post office. Space will not permit a more detailed account of these towns. The Census Bureau of Washington, D. C., does not give the population of unincorporated towns; hence, the population as given below is as estimated by the postmaster of each place in May, 1912. Those in black face type are largely coal mining villages:

	Population. 1912.		Population. 1912.
Beechwood	150	McCurdyville (Center P. O.)	30
Bula	40	**Opekiska**	95
Cassville	100	Pentress	100
Charlotte	42	Randall (Jimtown)	52
Core	25	**Richard**	250
Crossroads	31	Sabraton	2200
Daybrook	110	Saint Cloud	15
Dellslow	100	Statler Run	40
Easton	60	Stewartstown	50
Laurel Ironworks	—	Uffington	50
Laurelpoint	77	Vanvoorhis	29
Little Falls	35	Wadestown	52
Maidsville Landing	36	Wana (Wise)	200
Mona (Granville)	350	Whiteday (Smithtown)	44

MARION COUNTY.

Marion county is bounded on the north by Monongalia county; on the east by Monongalia and Taylor; on the south by Taylor and Harrison; on the west by Wetzel. Its area as determined by planimeter from the accurate topographic sheets of the U. S. Geological Survey, by districts, is as follows:

Districts.	Sq. Miles.
Mannington	100.09
Pawpaw	39.76
Lincoln	56.63
Fairmont	20.69
Grant	25.44
Winfield	39.61
Union	31.33
Total for county	313.55

Marion county, according to Lewis[3], was formed from Monongalia county by an act of the Assembly of Virginia, passed January 14, 1842, and was named in honor of General Francis Marion of Revolutionary fame.

The general surface of the county varies in elevation from 847.33 feet above tide—normal elevation of Pool No. 14 of the U. S. Government's lock and dam system for the Monongahela river—to 2003 feet above the same datum at the cross-roads in the extreme eastern point of the county, a range in elevation of 1156 feet.

Population.—In 1900 the population was 32,430, of which 31,942 were white; 482, colored; and 1,769, foreign born. The census of 1910 gives the total population as 42,794, a gain of 10,364, or an increase of 31.9 per cent. The following table exhibits the changes in population in Marion county by magisterial districts during the last two decades, as determined by the Census Bureau at Washington, D. C.:

Districts—Marion County.	Population.		
	1910	1900	1890
Mannington, including Mannington city	8050	7350	5605
Pawpaw, including Fairview and Rivesville towns	4239	2636	2311
Lincoln, including Farmington and Worthington towns and part of Monongah town	6278	4082	2982
Fairmont, including Barnstown village and wards 2 and 5 of Fairmont city	11780	7034	3228
Grant, including part of Monongah town	4885	4864	2085
Winfield	2391	3127	2191
Union, including ward 1 of Fairmont city	5171	3337	2319
Totals for county	42794	32430	20721

A glance at the above table will show that by far the greatest increase in population from 1900 to 1910 in Marion county has taken place in the oil and gas, and the coal mining districts of the county, due largely to the influx of labor incident to the development of these mineral resources. Winfield district which has had no new coal mines, and no oil and gas development, shows a loss during the same period of 23½ per cent. Another cause of increase in Fairmont and Union

3. History of West Virginia, page 675, V. A. Lewis; 1889.

districts has been the rapid industrial growth of the city of Fairmont.

Products.—The principal farm products of Marion county are corn, wheat, oats, hay, potatoes, garden vegetables, apples, peaches, dairy products, beef cattle, sheep and poultry.

The principal mineral and manufactured products are coal, coke, petroleum, natural gas, building stone, glass ware, china pottery, wall plaster, brick, mining machinery and lumber.

The State Auditor gives the following assessed property valuations for Marion county for the three years ending with 1912:

	1910.	1911.	1912.
Real Estate	$33,405,795	$34 585,270	$35,582,955
Personal Property	10,600,405	10,767.585	11,000,440
Totals	$44,006,200	$45,352,855	$46,583,395

Marion, according to the above, ranks third in point of wealth among the counties of the State, Ohio coming first and Harrison second.

The incorporated town in the county are as follows: Fairmont, Mannington, Monongah, Fairview, Barnstown, Farmington (Underwood), Worthington and Rivesville.

Fairmont.

Fairmont, the county seat of Marion county, is the largest and most important city in the county. It is located along both banks of the Monongahela river, one-half mile northeastward from the junction of West Fork and Tygart Valley rivers, being principally on high terraces or old erosion levels of the Monongahela river, 150 to 200 feet above the stream, and was incorporated as a city, February 18th, 1899. On pages 675 and 676 of his History of West Virginia, Lewis says:

"Fairmont, then called 'Middletown,' in Monongalia county, was established a town, by act of Assembly, January 19, 1820, on lands of Boaz Fleming, with John S. Barnes, John W. Kelly, Josiah Wolcott, John H. Polsley, Jesse Ice, Benoni Fleming and Thomas Fleming, trustees. By an act of February 4th, 1843, the name was changed from Middletown to Fairmont."

During the period from 1900 to 1910, it has enjoyed a very rapid growth both in population and in industrial activity. In 1900 the population was only 5,655, but the census of 1910 gives it 9,711, a gain of 4,056, or an increase of 71.7 per cent. It is now the seventh city of the State, having 510 more people than Clarksburg, the eighth city; and 987 less than Martinsburg, the sixth.

State Institutions.—Fairmont has two State institutions located within its corporate limits; viz., Fairmont State Normal School, and Miners Hospital No. 3.

Fairmont State Normal School.—The grounds and buildings of this school are located along Fairmont Avenue in the southwest portion of Fairmont. It is maintained by the State largely as a school for the training of public school teachers. The following account of this institution is given on pages 285 and 286 of Vol. I of the West Virginia State Board of Control:

"**History.**—The Fairmont State Normal School began its existence in 1865, as an enterprise of the citizens of Fairmont. In 1867, the Legislature united with the town in the construction of a building, which for a long time was used by the State Normal School and the Fairmont public schools jointly. Its first President was Dr. J. B. Blair, who served until 1878. The ability of Dr. Blair and the splendid management of the institution gave it a most excellent standing, especially in the northern end of the State.

"**Grounds and Buildings.**—In 1893, the school was moved into its present grounds and building. The grounds consist of a single block, fronting on Fairmont Avenue. This land was obtained at a nominal price, in 1892, when the section of Fairmont in which the school is now located was just beginning to build up; it is now very valuable.

"There are two buildings for the use of the school.

"First, the school building erected in 1893. This building is constructed of red brick with stone sills and lintels. It is well proportioned and presents an imposing appearance. It has a frontage of 100 feet, with a depth of 150 feet.

"The basement contains gymnasium rooms for ladies and gentlemen, janitor's room, storage rooms, and rooms for the heating apparatus.

"The first story contains four recitation rooms for the teachers of French and German, of Mathematics, of English Language and Literature, of History and Civics, the Physics and Chemical Laboratory, and a room for the Training School. These comprise the kindergarten room (the children of the grades), school room and the lecture room for the Training School teachers.

"The second story contains an attractive chapel which is used for morning exercises and as a daily study hall, the rooms of the teachers of Latin, of the Assistant in English, of the Art Teacher, also the Library, the offices of the President, and the First Assistant.

PLATE V.—Fairmont State Normal School.

"The third story contains the large auditorium, one of the most attractive and satisfactory assembly halls in the State. It is capable of seating 1000 people. It is furnished with opera chairs, and as one of its ornaments, has a grand concert piano. Also on the third floor is the private instruction room of the teacher in instrumental music, and two large halls for the Mozart and Lyceum societies.

"The building is not well constructed, and is entirely insufficient to meet the demands of the school.

"The other building is a dormitory for women. This is an attractive three-story building, adjoining the Normal building, containing kitchen, pantry, large dining-room with seating capacity for forty-four, rooms for the house-keeper and family, seven large rooms for teachers, and twenty-two rooms for women students, besides parlors, study hall and reception halls. * * * *

Statistical Tables, 1910-1912.

From Vol. II, Part II, W. Va. State Board of Control, pp. 145-146.

Table No. 1.

Enrollment, 1910-1911.

	Senior.	Junior.	Sophomore.	Freshman.	Saturday Students.	Summer School (New).	Males.	Females.	Total.
Normal Course	77	....	....	....	....	....	....	....	....
Academic	11	....	....	....	....	....	....	....	....
Total	88	63	156	237		49	159	434	593

Table No. 2

Enrollment, 1911-1912.

	Senior.	Junior.	Sophomore.	Freshman.	Saturday Students.	Summer School (New).	Males.	Females.	Total.
Normal Course	87	....	....	....	....	....	....	....	....
Academic	9	....	....	....	....	....	....	....	....
Total	96	56	110	202	30	31	191	334	525

Miners Hospital Number Three.—This institution is located on Guffey street in First Ward of Fairmont, and is one of three such hospitals maintained by the State for injured miners. On page 133 of the above mentioned volume, is given the following account of the same:

"The site was the gift of the citizens of that City. The Hospital was opened October 1, 1901, with a capacity for about thirty patients, which has been increased so that there is now room for fifty. The admission of patients to the Hospital has increased steadily year by year.

"The grounds comprise an area of one acre, fronting on Guffey street in the First Ward of the city of Fairmont, easy of access, about four blocks from the B. & O. Railroad station, with water, gas, electric lights and an excellent sewerage system. The grounds have perfect drainage, paved walks and roadways that are lighted with electricity.

"The main building is of two stories with finished basement, is of stone foundation red brick walls, with corner finish of buff shale brick, slate roof."

On pages 135-141 of the same reference are given statistical tables showing nationality of those admitted, occupation, civic conditions, race and nature of injuries of all patients treated from Oct. 1, 1908, to Sept. 30, 1910.

Glass Industries.—Fairmont is also an important glass producing city having five separate factories, the comparatively low price of natural gas offered manufacturers having been instrumental in bringing the plants there. A brief description will now be given of the same from data collected by Mr. Reger:

Fairmont Bottle Company.—This is Fairmont's oldest glass factory and it is located in the southwest portion of the city. According to Robert Johns, Manager, the head office is at Fairmont, and the plant was established in 1892. It makes both flint glass bottles and jars. Its specialty is milk bottles. The ware is both hand and machine blown. Teeple and Johnson machines are used; capacity, 4 carloads weekly. The sand comes from Berkeley Springs, Morgan county, and from Hancock, Md., the lime from Ohio (that from Martinsburg, W. Va., being considered too dark for the purpose), and the soda, from Michigan. Employment is furnished for 50 to 60 persons, 30 of whom are skilled workers.

Monongah Glass Company.—This plant and its main of-

PLATE VI.—Miner's Hospital No. 3, at Fairmont.

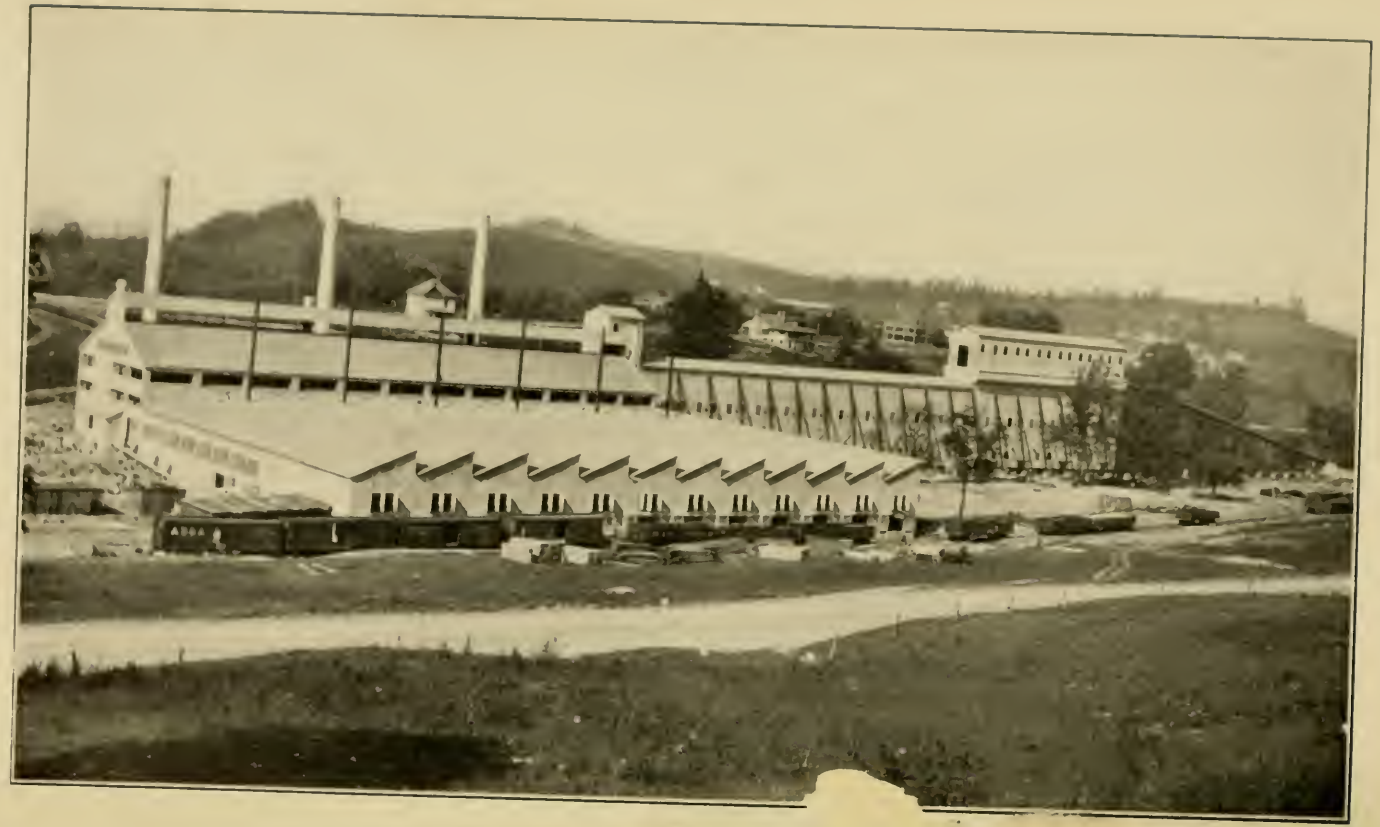

PLATE VII.—Owens W[illegible]rginia Bott

fices are located in the southwestern portion of Fairmont. According to H. L. Heintzelman President, it was incorporated in December, 1903, and started to operate in August, 1904. It makes pressed and blown tumblers, stem ware and kindred lines; capacity, 900 barrels daily. All ware is hand blown, no machines being used, makes both lime and lead flint glass. The sand comes from Hancock, Maryland, the lime from Ohio, and 800 persons—550 men, 125 boys and 125 girls—275 of whom are skilled workers, are employed.

Fairmont Window Glass Company.—This plant is located along the "Belt Line" in the southwestern portion of Fairmont. According to O. A. Wood, President, it was established in 1905, and has its principal office in Fairmont. It manufactures hand-blown window glass exclusively, and has a capacity of 3,000 boxes weekly. The sand comes from Dunbar, Pa., and the lime from Martinsburg. Employment is furnished for 150 persons, all men, 77 of whom are skilled workmen.

Cumberland Glass Company.—This plant is also located along the "Belt Line" in the southwest portion of Fairmont, but when visited by Mr. Reger in October, 1911, it was shut down. According to Granville Greathouse, caretaker at that time, it was first run under the name, "National Glass Company." Wm. George & Bros. of Pittsburgh are agents for the company. It manufactures tumblers, stem ware, etc., and about 150 persons—men, boys and girls—were employed.

Owens W. Va. Bottle Company.—This plant is located on the east side of the Monongahela river, at the southeast edge of Fairmont. According to data given by S. S. Cochrane, Supt., it was established in 1910, and has its head office at Toledo, Ohio. It manufactures machine blown bottles exclusively, having a capacity of 400,000 gross yearly. The sand comes from Hancock, Md., and the lime, from Toledo, Ohio. The special Owens Bottle Machine is used, and 200 persons—all men—50 of whom are skilled workmen, are employed.

Miscellaneous Industries.—In addition to the glass business, there are several other industries located in or near

Fairmont. A short description of the same will now be given from data collected by Mr. Reger:

Fairmont Wall Plaster Company.—This plant is located along the "Belt Line" in the southwest portion of Fairmont. According to W. T. Block, Secretary, it was established in 1901, and has its principal office in Fairmont. It manufactures Rock wall plaster and cement building blocks. The sand comes from the Monongahela river, and the calcine, from the State of Ohio. The capacity of the plant is 25 tons daily, and 20 persons, 5 of whom are skilled workers, are employed.

Helmick Foundry-Machine Company.—This plant is located along the "Belt Line" in the southwestern portion of Fairmont. According to Fred Helmick, Gen'l Manager, this factory was established in 1901, and it manufactures coal mine and coke plant equipment. The sharp sand used comes from the Lilly quarry near Colfax, and the loam sand from the Monongahela river flood plain at Fairmont, near high water level, and 50 persons, 75 per cent of whom are skilled workmen, are employed.

Mountain City Stone & Foundry Company.—This plant is also located along the "Belt Line" in the southwest portion of Fairmont. According to W. E. Means, Superintendent, the factory was established in 1905, and it manufactures glass moulds and general foundry products. The foundry sand comes from the Monongahela river flood plain, near the railroad in Fairmont, and 5 persons, 1 of whom are skilled workmen, are employed.

Fairmont Mining Machinery Company.—This plant is located in the same portion of Fairmont as that last described. According to H. B. Hungerford, Superintendent, this factory was established June 1st, 1906, and it manufactures mining machinery and supplies. Employment is furnished for 200 persons.

West Virginia Metal Culvert Company.—This plant is located on the east side of the Monongahela river, at the southeast edge of Fairmont. According to Edward Limburg, formerly a manager of the concern, it was established in 1907, and manufactures corrugated metal road culverts. It was not

Photo by Ray Bricker.

PLATE VIII.—Topography of the Monongalia Series at Hoult, Marion County. Lock No. 15 of Monongahela River in foreground.

in operation when visited by Mr. Reger in October, 1911. When running full, 5 men, all skilled workmen, are employed.

Reeves Handle Works.—This plant is located in the same portion of Fairmont as that last described. According to data given by J. W. Reeves, owner, this factory was established in 1909, and manufactures straight wooden handles of all kinds, single-trees, neck-yokes, breast-yokes, ladders, telephone pins, etc., and employs 4 men, all of whom are skilled workmen.

The Willetts Company.—This plant is located on Hickman run, one mile southeast of the B. & O. R. R. station at Fairmont, and is engaged in the manufacture of clay products for glass factories. It was established in 1887 and reorganized June 15, 1909, having its principal office in Pittsburgh, Pa. Both domestic and imported fire clays are utilized, and the product is both machine and hand made, giving an annual capacity of 5,000 tons, employment for 25 men, and a monthly pay roll of $1,000.00. The factory runs 12 months in the year, but in January, 1913, it was not yet in full operation.

Mannington.

Mannington, the second largest city of Marion, is located in the west central portion of the county on Buffalo creek, and the main line of the Baltimore & Ohio R. R. It was incorporated as a town March 4, 1856, and as the City of Mannington in 1905. In 1900 its population was 1,681, and 2,672 in 1910, a gain of 991, or an increase of 58.9 per cent. Its rapid growth during the last two decades has been largely due to the development of the great oil and gas fields in the surrounding region, the South Penn Oil Company, a former subsidiary concern of the Standard Oil Company of New Jersey, having extensive shops here.

Homewood Pottery Company.—This plant is located along the Baltimore & Ohio Railroad, one-fourth mile east of Mannington. According to Geo. W. Bowers, President, this concern was established in 1904, and it manufactures plumbers earthenware, the output of the plant being equipment for 200,000 closets and tanks yearly. One-half the clay

used comes from England, and the other from North Carolina, the flint, from Maryland, and the spar, from Maine. It employs 250 persons—243 men and 7 girls—of whom 175 are skilled workers.

Monongah.

Monongah, the third largest town in Marion, is located along both banks of West Fork river, at the mouth of Booths creek, and was incorporated as the Town of Monongah, September 12, 1891. In 1900 it had a population of 1,786, and 2,084 in 1910, a gain of 298, or an increase of 14.3 per cent. A large proportion of the population are miners who work in the coal mines in the vicinity. A trolley line, and the Monongahela River Branch of the Baltimore & Ohio Railroad, connect it with Fairmont and Clarksburg.

Fairview.

Fairview, the fourth town of Marion, with a population of 782 in 1910, is located near the head of Pawpaw creek in the northern edge of the county, and is connected with the county seat by a trolley line, extending down the latter stream to Rivesville, and thence up the river to Fairmont. It is surrounded by a great oil and gas field and a fairly rich agricultural community.

Barnstown.

The village of Barnstown, with a population of 655 in 1910, is located at the north edge of Fairmont along Buffalo creek, and was incorporated in 1906. A large percentage of its residents are coal miners. It is connected with Fairmont by trolley line, and the Baltimore & Ohio Railroad.

Barnesville Manufacturing Company.—This plant, which was established in 1865, is located in Barnstown and manufactures woolen goods. According to T. J. Titherington, Superintendent, the product consists of flannels, blankets and dress goods, 400 to 450 pounds of wool being used daily. The

equipment consists of a 1 set mill with 14 looms. There are 28 employees—16 men and 12 girls—all being skilled laborers. The monthly payroll is $1,200.

Farmington (Underwood).

Farmington, known as Underwood station on the Baltimore & Ohio R. R., with a population of 519 in 1910, is located on Buffalo creek, 10 miles westward from Fairmont, and is connected with the latter place and Mannington by the last railroad mentioned and a trolley line. It was incorporated as the town of Farmington in April, 1901. It has had a rapid growth during the last decade due to the development of the Pittsburgh coal in the immediate vicinity of the town. It is also surrounded by a fairly rich agricultural region and a great natural gas field.

Worthington.

Worthington, with a population of 292 in 1910, is located 7 miles southwest of Fairmont along the West Fork river, one-fourth mile below the mouth of Tevebaugh creek, and is connected with Fairmont by a trolley line and the Monongahela River Branch of the Baltimore & Ohio Railroad. It is largely a coal mining town, and is also surrounded by a great natural gas field.

Rivesville.

The town of Rivesville is located on the west bank of the Monongahela river at the mouth of Pawpaw creek, 3½ miles northeastward from Fairmont, and is connected with the latter place by a trolley line and the Pawpaw Branch of the Baltimore & Ohio Railroad, and with Morgantown by the Buckhannon & Northern Branch of the Pittsburgh & Lake Erie R. R. In 1900 its population was 164, and 190 in 1910, a gain of only 26. The town promises to have a rapid growth during the next decade, however, owing to the development of the coal mining industry in the immediate vicinity.

In addition to the above described incorporated cites and towns in Marion, there are a large number of unincorporated villages scattered over the county, a number of which are merely represented by a cross-roads store and post office, while others are largely coal mining towns with several hundred population. These have been arranged below in alphabetical order, and their population indicated for 1912, as given below, except those marked with an asterisk, is as estimated by the postmaster at each place for May, 1912, since the Census Bureau does not determine separately the population of unincorporated town. Those in black face type are largely coal mining villages:

Towns.	Population. 1912.	Towns.	Population. 1912.
Annabelle	875	Hammond	300
Barrackville	750	Hoult	150
Boothsville	150	*Hutchinson	177
Catawba	300	*Kingmont	50
Chiefton	319	Logansport	38
Colfax	80	*Metz	165
Downs	250	*Montana Mines	435
Everson	300	**Murray (Scottdale)**	100
Galletin	37	*Powells	69
Glover Gap	210	Rymer	60
Grangeville	——	Sevenpines	16
Grant Town	700	**Watson**	1800
*Graysflat	96	Winfield (Canton)	65

TAYLOR COUNTY.

Taylor county is bounded on the north by Marion and Monongalia; on the east by Preston; on the south by Barbour; and on the west by Harrison. Its area as determined by districts with planimeter from the accurate topographic sheets of the U. S. Geological Survey, is as follows:

Districts.	Sq. Miles.
Booths Creek	42.92
Flemington	18.54
Courthouse	34.66
Fetterman	53.36
Knottsville	27.71
Total for county	177.17

*Rand-McNally's Shipper's Guide for W. Va., 1911.

According to Lewis[4], Taylor county was formed from Harrison, Barbour and Marion counties by an act of the General Assembly of Virginia, January 19, 1844, and named in honor of General Zachary Taylor. The act creating the county, fixed the seat of justice at Williamsport now Pruntytown. The county seat was later transferred to Grafton.

The general surface of the county varies in elevation from 895′ A. T., Tygart Valley river level, one-fourth mile southeast of Powells, to 2003′ A. T. at the cross-roads near the extreme northern corner of Taylor, a range in elevation of 1108 feet.

Population.—According to the census of 1900, the population of Taylor was 14,978, of which 14,553 were white, 423, colored, and 384 foreign born. The census of 1910 gives the total population as 16,554, a gain of 1,576, or an increase of 10.5 per cent. The following table exhibits the changes in population in Taylor county by magisterial districts during the period from 1890 to 1910, as determined by the Census Bureau at Washington, D. C.:

District—Taylor County.	Population.		
	1910	1900	1890
Booths Creek	1558	1589	1663
Flemington	1647	1707	1119
Courthouse, including Ward 5 of Grafton city	4402	3448	2483
Fetterman, including part of Ward 1, Grafton city	2982	2585	2495
Grafton, comprising Wards 2 and 4, and part of Ward 1 of Grafton city	4672	4346	3159
Knottsville	1293	1303	1228
Totals for Taylor county	16554	14978	12147

A glance at the above table will show that the rural districts, represented by Booths Creek, Flemington and Knottsville, have lost in population during the period from 1900 to 1910, while those including parts of the city of Grafton have gained in the same decade. The same conditions have con-

4. History of West Va.; page 684, V. A. Lewis; 1889.

tributed to this decrease in the rural regions of the county as in Monongalia and Marion.

Products.—The farm products of Taylor county are corn, wheat, oats, hay, potatoes, garden vegetables, apples, dairy products, beef cattle, sheep and poultry.

The principal mineral and manufactured products are coal, natural gas, lumber, glass ware, wall tile and building stone.

The State Auditor gives the following assessed property valuations for Taylor county for the three years ending with 1912:

	1910	1911	1912
Real Estate	$ 9,726,060	$ 9,940,810	$10.143,810
Personal Property	2,835,210	3,182,920	3,130,430
Totals	$12,561.270	$13,123,730	$13,274,240

A brief description will now be given of the most important towns in the county.

Grafton.

Grafton is the county seat of Taylor and the largest and most important city in the county. It is located along both banks of Tygart Valley river at the mouth of Threeforks creek, near the central portion of the county. It was incorporated March 15, 1856. During the period from 1900 to 1910 it has enjoyed a rapid growth both in population and industrial activity. In 1900 the population was only 5,650, and 7,563 in 1910, a gain of 1,913, or an increase of 33.8 per cent.

Industries.—The principal industries of Grafton are the manufacture of glass ware and wall tile, there being two factories of the former and one of the latter. A short description will now be given of each from data collected by Mr. Reger:

Tygart Valley Glass Company.—This plant is located along the main line of the Baltimore & Ohio Railroad on Berkeley run at the southwest edge of Grafton. According to Geo. McCaskey, Gen'l Manager, this factory was established in 1902, and it manufactures glass jars and bottles for

packing of pickles, olives and fruits. Semi-automatic machines are used, and the ware is lime flint glass. The sand comes from Berkeley Springs, Morgan county, the lime, from Tiffin, Ohio (July, 1911) but expects to use lime from Martinsburg, Berkeley county, W. Va., since on test it had given satisfactory results; and the soda ash, from Saltville, Virginia. It employs 165 persons—50 per cent, men, 35 per cent, boys, and 15 per cent, girls—of whom 75 per cent are skilled workers.

Dominion Window Glass Company.—This plant is located on the north side of Threeforks creek along the main line of Baltimore & Ohio R. R. in the east end of Grafton. According to W. R. Loar, formerly president of the company, this factory was established in 1904, and is now leased to the W. R. Jones Window Glass Company of Columbus, Ohio. It formerly manufactured hand blown window glass exclusively, having a capacity of 500 boxes daily, but has recently been converted to a machine blowing plant. The sand comes from Crellin, Maryland, and the lime, from Martinsburg. It employs 175 men, 150 of whom are skilled workers.

Columbia Tile Company.—This plant is located on the east bank of Tygart Valley river in the northwest edge of Grafton on the site formerly occupied by the Empress Glass Co. According to Wm. H. McGee, Superintendent, it was established in 1911. The product consists of glass tile, having a patent undercut attachment, prism tile, and special lines of pressed glass ware in crystal, opal and other colors. The equipment includes a 10 pot furnace with 2 continuous tanks. Sand from Berkeley Springs is used. 100 men, 95 of whom are skilled, and 50 boys are employed. Mechanical tests of the product will be given in Chapter XIII.

Grafton is also an important railroad center for the Baltimore and Ohio R. R., and many of its residents find employment on the railroad and in the extensive shops of the latter at this place.

Pruntytown.

Pruntytown, located along the Northwestern Virginia

turnpike, 3 miles westward from Grafton, is one of the oldest towns in the county, and was the original county seat of Taylor. Lewis[5] gives the following account of this place:

"Pruntytown—then in Harrison county—was established a town under the name of Williamsport, January 8, 1801, on lands the property of David Prunty, at a place called the 'Cross Roads,' and Peter Plummer, James Cochran, John Asbury, Peter Johnson and Vincent Leek were appointed trustees. By an act of Assembly, January 23, 1845, the name was changed from Williamsport to Pruntytown. The act creating the county fixed the seat of justice at Williamsport."

The town is surrounded by a fairly rich agricultural region, and its population in 1910 was about 300, exclusive of the Reform School.

West Virginia Reform School.—The State Reform School for boys is located at Pruntytown. This institution was created for the care, instruction and reformation of boys under 18 years of age. The following interesting account is given of this school on page 171 of Vol. I of the State Board of Control:

"The West Virginia Reform School came into existence by virtue of the act of the Legislature passed in 1889. The Commission to select a site located it at Pruntytown, which was formerly the county seat of Taylor county, four miles west of Grafton, which city is now its post office and railroad station. The old Court House and site were given by Taylor county to the institution, and $5,000.00 was contributed by the county for the purchase of additional grounds. The entire acreage of the grounds of the institution is about 175. With the exception of the part of it immediately occupied by the buildings and their lawns, it is mainly used for grazing. It is rough hillside land with hard soil; there is not even a sufficient quantity of it suitable for gardening purposes so much needed at the institution.

"The Legislature of 1909 made an appropriation of $30,000.00 for a farm, the amount to be expended under the direction of the Board of Control.

"To find proper employment for a large portion of boys not adapted to any of the trades, the Superintendent has resorted to leasing lands from adjoining farmers, and now has several tracts under lease. These leases run from one to three years and invariably result in improving the condition of the land leased. If the State had lands of its own upon which this labor and care could be bestowed and followed up from year to year, it could be made very instructive in agricultural pursuits, as well as financially profitable. We call attention to the fact that the farmers of the country with good land use hired labor and run their farms at a profit.

"The State has at this school an average of 267 boys, the great majority of whom are able, and in fact prefer, to work on the farm.

5. History of W. Va., page 684, V. A. Lewis; 1889.

This is the class that more easily submits to and profits by discipline. Experience shows that the very best results in reforming those boys are obtained in that class employed on the farm. If the institution had the proper land all the vegetables needed could be produced with a surplus for other State institutions. Under present conditions, better results are not obtainable."

Recently a new building has been completed for the colored boys of the school. In 1910 the buildngs were as follows: Administration Building, for older and larger white boys; Central Dining Hall; Kunst Cottage, for white boys of intermediate size; Davisson Cottage, for the colored boys; Robinson Cottage, for the small white boys; Shop Building containing blacksmith shop, carpenter shop, shoe shop, laundry, power house and tailor shop.

Webster.

Webster is located on Berkeley run along the main line of the Baltimore & Ohio Railroad, 3.5 miles southwest of Grafton. It is surrounded by a fairly rich agricultural region. In May, 1912, its population was 300, as estimated by the postmaster.

Webster Woolen Mills Company.—This plant is located in Webster, but has its main office in Grafton. According to R. E. Senior, Superintendent, this factory was established in 1868, and it manufactures woolen blankets, having a daily capacity of 75 to 100 pairs. The wool used is obtained from eastern markets, and 26 persons are employed, 19 of whom are women, ten of the latter being skilled workers.

In addition to the above described towns in Taylor, the following is a list of other villages in the county of which space does not permit a detailed description. The population is as estimated by the postmaster of each place in May, 1912, since the Census Bureau at Washington, D. C., does not give separately the population of unincorporated towns. Those in black face type are largely coal mining villages:

	Population. 1912.		Population. 1912.
Cecil	35	**Simpson**	500
Flemington	500	Thornton	150
Knottsville	60	**Tyrconnel (Rosemont)**	600

CHAPTER II.

PHYSIOGRAPHY.

The principles of physiography have been so often discussed in foregoing county reports of the State Survey by the writer[1] that space will not be taken in this volume to repeat the same. The southern terminus of the great northern glacier referred to therein was 60 to 70 miles northwestward from the Monongalia-Marion-Taylor area, but the indirect effects of its flood and water spread over a large portion of the three counties; viz., along the valleys of the Monongahela and Cheat rivers, and their tributaries.

A glance at Map I will show that Monongahela and Cheat rivers have a distinct northward trend. This feature is evidence that they belong to the ancient, preglacial drainage system running northwestward from the site of Pittsburgh via Beaver and Beaver Falls, Pa., into the St. Lawrence drainage basin.

DESCRIPTION OF THE DRAINAGE BASINS.

The following table exhibits the rate of fall per mile of the principal streams of the three counties; their departure from a straight line course; and the ratio of the total distance between points on same, measured by the meanders of the stream, to the air line distance between the same points:

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1. Marshall-Wetzel-Tyler Report, pp. 32-37, 1909; Wirt-Roane-Calhoun Report, pp. 30-31, 1911; and Doddridge-Harrison Report, pp. 33-35, 1912.

STREAMS.	Total Fall. Feet.	Total Distance. Miles.	Rate of Fall per Mile. Feet.	Air Line Distance. Miles.	Ratio T. D. to A. L. D.
Monongahela river, Pa.-W. Va. line to West Fork	73	36.8	2.0	21.6	1.7
Tygart river, West Fork to Sandy creek	155	28.9	5.4	16.9	1.7
Dunkard creek, Wadestown to Shamrock	54	6.0	9.0	4.8	1.3
Dunkard creek, Shamrock to Mt. Morris	71	20.4	3.5	10.7	1.9
Dunkard creek, Mt. Morris to mouth	111	12.2	9.1	7.6	1.6
Scott run, Cassville to Randall	202	4.2	48.1	3.8	1.1
Indian creek, Hagans to mouth	175	6.7	26.1	5.7	1.2
Paw Paw creek, Fairview to Rivesville	140	8.9	15.7	7.9	1.1
Buffalo creek, Glover Gap to Mannington	60	7.2	8.3	6.2	1.2
Buffalo creek, Mannington to mouth	120	16.4	7.3	11.9	1.4
West Fork river, Bingamon creek to mouth	18	11.4	1.6	7.0	1.6
Booths creek, Boothsville to mouth.	72	7.5	9.6	4.8	1.6
Cheat river, Pt. Marion to Beaver Hole	88	16.8	5.2	10.7	1.6
West run, Easton to mouth	204	4.4	46.4	3.7	1.2
Deckers creek, mouth to Dellslow	191	5.9	32.4	4.2	1.4
Deckers creek, Dellslow to Falls run top Cascade Falls	650	5.6	116.1	4.7	1.2
Deckers creek, Cascade Falls to Reedsville	45	5.0	9.0	3.4	1.5
Booths creek, Uffington to Clinton Furnace	250	5.3	47.2	4.7	1.1
Whiteday creek, Opekiska to Anita	235	7.4	31.8	5.3	1.4
Whiteday creek, Anita to Marion-Taylor line	390	5.8	67.2	4.2	1.4
Prickett creek, mouth to Samaria	207	6.6	31.4	5.2	1.3
Threefork creek, Grafton to Hardman	121	9.8	12.3	7.6	1.3
Threefork creek, Hardman to Birds creek	210	7.9	26.6	5.8	1.4
Sandy creek, mouth to Little Sandy creek	284	6.6	43.0	4.2	1.6
Little Sandy creek, mouth to Fellowsville	75	8.8	8.5	4.3	2.0

The last column of the above table gives the total distance (T. D.) measured by the meanders of the stream to the air line distance (A. L. D.). It follows that the nearer this ratio approaches unity, the greater the rate of fall.

From the high rate of fall as revealed in the above table,

it is quite evident that none of the streams in the area under discussion has as yet reached base level with the Monongahela river, but the latter stream is fast approaching same with the Ohio at Pittsburgh. The streams possess wide meandering courses along with a rapid rate of fall; hence, it is quite evident that they possess the former character by inheritance.

The following table gives not only the area of the entire drainage basin of the Monongahela river above the mouth of Dunkard creek, three miles north of the W. Va.-Pa. State line, but the area of the drainage basins of several of its most important tributaries located wholly or in part within the Monongalia-Marion-Taylor area:

Table Showing Areas of Drainage Basins.

Streams.	Sq. Miles.
Monongahela river above mouth of Dunkard creek.	4385.0
Booths creek, Marion county	44.9
Booths creek, Monongalia county	21.7
Buffalo creek	125.2
Cheat river, portion included in Monongalia	46.6
Cheat river, total above mouth	1418.0
Cobun creek	11.6
Deckers creek, total above mouth	63.8
Dents run	14.5
Dunkard creek, portion in West Virginia	105.4
Dunkard creek, total in both States	227.4
Indian creek	21.5
Pawpaw creek	42.5
Pricketts creek	24.6
Sandy creek	90.0
Scott run	15.0
Threeforks creek	103.0
West Fork river, total above mouth	843.0
Whiteday creek	33.4

The above areas were determined by Mr. Reger with planimeter from the accurate topographic quadrangles of the U. S. Geological Survey, and from the State Geological map, the latter being accurate to the scale on which it is drawn.

A brief description will now be given of the drainage basins of the largest and most important streams of the three counties: viz., Monongahela, Cheat and West Fork rivers, and Dunkard, Deckers, Buffalo and Threeforks creeks.

Monongahela River.

The Monongahela river, named from an Indian word signifying sliding banks, is formed by the junction of West Fork and Tygart rivers, one-half mile southwest of Fairmont, from which place it flows northeastward across Marion and Monongalia counties, and thence northward in Pennsylvania to Pittsburgh, where with the Allegheny river it forms the Ohio. The tables given on preceding pages exhibit its rate of fall and the area of its basin above the mouth of Dunkard creek. Its Tygart Valley fork has its head in southern Randolph county at an elevation of 3,500 feet above sea level, but it falls to 858 feet at its mouth near Fairmont, a distance of about 100 miles. The headwaters are mountainous and its valley walls often steep and precipitous, the fall being rapid, causing heavy rains to run off swiftly, producing sudden and intense floods.

The U. S. Geological Survey, in order to determine the surface water supply of the Ohio river basin, established several gaging stations on its many large tributaries in West Virginia. One of these is located on the Tygart river at Fetterman, a suburb of Grafton, Taylor county. The following interesting data obtained at this station, is taken from Water Supply Paper No. 263 of the U. S. Geological Survey, pages 47 and 48, dated 1909:

"This station, which is located at the highway bridge at Fetterman, was established June 3, 1907, to obtain data for use in studying water power, water supply, pollution, flood control, and storage problems.

"Lost Otter creek enters from the west about one-half mile below the station.

"The winters are mild; ice does not form very thick and does not last long. The records are reliable and accurate; the datum of the gage chain attached to the bridge has not been changed.

"Sufficient data have not yet been collected to enable estimates of flow to be made.

Discharge measurements of Tygart River at Fetterman, W. Va. in 1909.

Date.	Hydrographer.	Width	Area of Section.	Gage Height.	Discharge.
		Feet	Sq. Ft.	Feet	Sec.-Ft.
May 19	A. H. Horton.....	267	1,470	4.20	722
November 16	A. H. Horton.....	268	1,580	4.56	1.080
December 5	G. L. Parker.....	269	1,410	4.11	620

Daily gage height, in feet, of Tygart River at Fetterman, W. Va., for 1909.

(Joseph Gerken, observer).

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
1.....	3.8	4.8	5.85	5.8	7.65	4.0	4.45	5.65	3.5	3.8	4.3	4.3
2.....	4.2	4.65	5.65	5.65	9.65	3.9	4.3	4.8	3.5	3.8	4.25	4.25
3.....	4.35	4.55	6.15	5.8	8.7	4.05	4.15	4.65	3.55	3.75	4.15	4.15
4.....	4.4	4.45	8.0	5.85	6.9	4.05	4.05	4.5	3.65	3.65	4.1	4.1
5.....	4.45	4.5	7.25	6.7	6.15	4.6	3.9	4.1	3.7	3.6	4.1	4.1
6.....	4.4	5.05	6.5	7.0	5.75	6.05	3.75	3.9	3.55	3.5	4.05	4.05
7.....	4.2	5.65	6.5	6.55	5.55	5.1	3.65	3.8	3.5	3.5	4.0	4.05
8.....	4.45	5.7	7.4	5.8	5.2	5.15	3.5	3.7	3.5	3.4	3.9	4.15
9.....	4.6	5.65	7.3	5.5	4.85	7.15	3.45	3.65	3.5	3.4	3.9	4.1
10.....	4.35	7.45	6.85	5.35	4.8	6.55	3.4	3.6	4.75	3.4	5.65	3.95
11.....	4.4	8.65	6.65	5.05	4.95	8.95	3.4	3.5	5.45	3.4	8.0	3.9
12.....	4.6	6.8	6.1	4.85	4.9	6.8	3.45	3.5	4.8	3.8	6.2	4.1
13.....	4.55	6.2	5.65	4.8	4.85	5.95	3.6	3.45	4.45	4.4	5.5	4.2
14.....	4.5	5.95	5.6	9.3	4.8	5.4	3.55	3.35	4.1	4.35	5.15	5.15
15.....	7.7	5.95	5.8	11.5	4.7	5.75	3.45	3.35	3.95	4.3	4.9	5.85
16.....	9.6	9.3	5.7	7.8	4.55	5.8	3.55	3.6	3.85	4.1	4.65	5.75
17.....	8.9	8.7	5.45	6.45	4.45	5.25	3.7	4.3	6.55	3.9	4.5	5.15
18.....	7.6	7.35	5.25	5.65	4.2	9.85	3.65	5.05	4.75	4.15	4.4	4.85
19.....	5.9	6.6	4.95	5.4	3.95	7.3	3.6	4.7	4.5	4.15	4.4	4.6
20.....	5.65	6.2	4.9	6.1	4.0	5.85	3.45	4.3	4.25	4.85	4.25	4.45
21.....	5.45	5.95	4.85	8.2	4.05	5.2	3.4	4.2	3.9	5.1	4.15	4.25
22.....	5.3	6.45	4.7	11.45	4.15	4.65	3.35	4.6	3.8	4.95	4.05	4.2
23.....	5.15	6.55	4.65	11.05	4.2	4.5	3.3	4.3	3.7	5.8	4.0	4.2
24.....	5.3	8.5	4.45	9.25	4.2	4.35	3.3	4.1	3.9	12.75	4.3	4.15
25.....	5.35	10.05	4.55	8.3	4.15	4.25	3.55	3.9	4.7	11.2	4.7	4.1
26.....	4.8	7.75	4.75	7.6	4.0	4.15	3.9	3.75	4.6	7.85	4.7	....
27.....	4.65	6.7	5.6	6.4	4.1	4.1	4.15	3.65	4.2	6.3	4.55	....
28.....	4.5	6.15	6.2	6.05	4.5	4.9	3.9	3.5	4.1	5.3	4.4	....
29.....	4.55	....	6.6	5.75	4.35	5.1	3.7	4.65	3.95	4.9	4.35	....
30.....	4.65	....	6.55	6.05	4.15	4.6	4.15	4.25	3.9	4.65	4.3	....
31.....	4.8	....	6.4	....	4.05	....	6.2	3.55	....	4.55	....	3.5

Note.—Ice conditions December 15 to 31. Frozen over December 22. Thickness of ice December 31, 0.3 foot.

A similar station was established by the U. S. Geological Survey at Enterprise, Harrison county, on the West Fork branch of the Monongahela, and the data there obtained, as taken from pages 49 and 50 of Paper No. 263 above, was pub-

PLATE. IX.—Topography of the Pottsville Series along Cheat River, looking south from Mont Chateau, Monongalia County.

lished on pages 37 and 38 of the Doddridge-Harrison report of the State Geological Survey. As mentioned in the Water Supply Paper above, the gages at neither of these stations have extended over a sufficient period of time to be reliable.

In the three counties under discussion, there occur several old abandoned erosion levels or terraces along the valley walls of the Monongahela river and its two large tributaries—Tygart and West Fork rivers. What appears to be an old abandoned channel of the Monongahela, occurs three-fourths mile eastward from Fairmont. The present channel of Hickman run, where the latter has a northeast-southwest direction, occupies this old river bed which can easily be followed in its crescent shape to an intersection with the present river channel, one-fourth mile below the mouth of Buffalo creek.

On the point between the two rivers, immediately southward from Watson, large deposits of quicksand have been deposited at the 950 to 1050′ A. T. level as the channels of these streams swerved back and forth during the glacial period. The several terraces of the Monongahela will be treated more in detail under the discussion of the topography of the land area in this chapter.

Cheat River.—Cheat river, the largest West Virginia tributary of the Monongahela, empties into the latter at Point Marion, Pa., 1.5 miles northward from the W. Va.-Pa. State line. It has its head in the northwestern border of Pocahontas county at an elevation of 4000 feet above sea level, and falls to 780 feet at its mouth. From Parsons to Rowlesburg the river falls from 1630 to about 1360′ A. T., in a distance of 33½ miles, or at the rate of 8.1 feet to the mile. From Rowlesburg to the State line, it falls from about 1360 feet to 787′ A. T., in a distance of 40 miles, or at the rate of 14.3 feet to the mile. The total area of its drainage basin, as given in the table on a preceding page, is slightly over 1400 square miles, and the mean annual rainfall[2] therein is from 45 to 50 inches; hence, the great possibilities for power development along this stream.

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2. Water Supply Paper No. 263, page 46, U. S. G. Survey; 1909.

As evidence that this great source of power is not being overlooked by private capital, its development has already been started on an immense scale by the W. Va. Development Company of Pittsburgh, Pa. This company plans to build a series of great dams, 50 to 80 feet in height, the first of which is to be located in the northern edge of Monongalia county, about 500 feet southeastward from the river's intersection with the State line. These great impounding reservoirs will virtually control the flood waters of this river, and tend in no small measure to reduce the damages from floods in the Pittsburgh district.

A gaging station, similar to those mentioned on preceding pages for Fetterman and Enterprise, was established by the U. S. Geological Survey on Cheat river near the Ice's Ferry bridge, about 7 miles above the State line. The following interesting facts, obtained at this station, were taken from Water Supply Paper No. 263 of the U. S. G. Survey, pages 51-62.

"This station, which was maintained from July 8 to December 30, 1899, July 1 to December 29, 1900, and August 21, 1902, to December 31, 1905, was reestablished November 18, 1908, by F. W. Scheidenhelm, through whose courtesy the 1908 and 1909 discharge measurements and gage heights have been furnished to the United States Geological Survey for publication.

"The data are of value for determining the quantity of water available for power and storage and the effect of Cheat river run-off on floods and pollution of Monongahela river.

"The staff gage for this station was originally located about 100 feet above the present location of Ice's ferry bridge at Uneva, W. Va., about 6 miles northeast of Morgantown and 10 miles above the mouth of Cheat river. The 1899 measurement was made from a cable which was located at the gage. During 1900 the cable was moved downstream about 1 mile and all subsequent measurements were made at the new cable location except those stated to have been made at wading sections or at Ice's ferry bridge. The first four measurements made during 1899 to 1901 were referred to the staff gage immediately above the present location of Ice's ferry bridge.

"On August 20, 1902, a new inclined and vertical staff gage was installed about 275 feet below the new cable section. The readings were made on the inclined section below 6.5 feet. The new gage was set to read the same as the original gage at 1.8 feet. On September 28, 1904, the inclined portion of this staff gage was found to be 0.35 foot too high and the vertical section 0.15 foot too high. Both sections were accordingly lowered. On September 28, 1904, a chain gage was established on Ice's ferry bridge to read the same as the second staff gage at 1.85 feet. Both gages were maintained from September 28, 1904, to December 31, 1905. The staff gage was maintained from November 18, 1908, to May 8, 1909, and the chain gage has been maintained from January 21, 1909, to date. From these simultaneous gage readings the following gage relation has been determined:

PLATE X.—Topography of the Pottsville, Mauch Chunk, Greenbrier and Pocono Series, looking south from Cooper Rock, Monongalia County.

Relation of gages on Cheat River.

Chain gage.	Staff gage.	Chain gage.	Staff gage.
Feet	Feet	Feet	Feet
1.5	1.52	6.5	7.69
2.0	2.00	7.0	8.28
2.5	2.52	7.5	8.87
3.0	3.11	8.0	9.43
3.5	3.78	8.5	9.98
4.0	4.46	9.0	10.53
4.5	5.15	9.5	11.06
5.0	5.82	10.0	11.59
5.5	6.47	10.5	12.11
6.0	7.09	11.0	12.65

"All discharge measurements and gage heights from 1902 to 1909, as published below, are referred to the second staff gage. All gage heights from 1902 to September 28, 1904, have been reduced to the gage zero established September 28, 1904. Gage heights previously published for 1899-1900 are referred to the original staff gage and are correct as originally published.

"The original staff gage and the chain gage are located in a deep pool, with large islands about one-fourth mile above and below the station. The second staff gage is also located in a deep pool of somewhat smaller dimensions than at the original location. It is situated nearly one-fourth mile below a large island and a short distance above a small island. Both pools are controlled by permanent rock reefs. Water was diverted around the lower gage for milling prior to 1908. The quantity thus diverted was relatively small (see table of discharge measurements) except at low stages, and has been disregarded in the following computations of discharge, but should, however, be taken into consideration in making use of the tables to determine the run-off in the Cheat river drainage basin. No important tributaries enter Cheat river near the gaging station.

"Large ice jams sometimes occur at this station. In January, 1904, the ice piled up from 8 to 10 feet above normal low-water stage, thus greatly affecting the relation of gage height to discharge. For the occurrence of other periods of ice effect, as determined by observer's records and climatological reports, see gage-height table footnotes.

"The discharge for these periods has been estimated, and it is assumed that the open-channel rating applies for all other winter periods.

"The curves developed are very satisfactory and the daily and monthly discharge values given in the following table are considered very good, with the possible exception of those for 1902-3, for which period there is some doubt about the elevation of the inclined gage. However, as the two measurements made during 1902-3 plot practically on the 1904-1909 discharge curve, when their gage heights are increased 0.35 foot, it is evident either that the inclined gage was set incorrectly at the time of its installation by the amount of the error in the gage (0.35 foot) discovered during 1904 or else that conditions of flow were different in these two years from what they have been since.

In either event the correctness of all gage heights for 1902-3 in accordance with the discrepancies found September 28, 1904, will yield essentially correct results for these years, and these corrections have accordingly been made.

"The discharge for low stages during 1899-1900 is also somewhat open to question. It has been impossible as yet to determine the period when Ice's ferry bridge was erected. The somewhat conflicting statements obtained seem to indicate that the bridge was built during 1900 or 1901. In any event it is probable that both the measurements made during 1901 were affected by the backwater from the bridge. This backwater effect is, however, very slight at low stages, owing to the deep, wide pool in which the gage is located. The two rating curves probably converge to a common curve at some point above the stage of zero flow. Hence at low stages the 1899-1900 discharges may be too high.

Discharge measurements of Cheat River near Morgantown, W. Va., in 1899-1905, 1908, 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1899		Feet.	Sq. ft.	Feet.	Sec.-ft.
July 8a	E. G. Paul	367	2,160	2.60	1,150
1900					
June 25b	do	292	1,240	2.80	c1,400
1901					
July 26d	do	282	1,060	2.30	710
Nov. 5e	do	139	167	1.45	222
1902					
Aug. 20b	do	275	940	2.10	299
1903					
Sept. 1b	do	283	1,090	2.65	f672
1904					
July 6b	Hoyt and Hall	300	1,230	2.95	773
Sept. 16g	R. J. Taylor	275	887	2.00	136
1905					
Mar. 17h	Grover and Morse	388	2,750	5.56	5,720
Do b	do	320	1,950	5.62	5,940
1908					
Nov. 18i	Scheidenhelm and Custer	83	73.7	1.61	131
Dec. 9j	L. B. Custer	171	141	1.86	223
1909					
Jan. 21k	Horton and Scheidenhelm	385	2,450	4.16	2,410
Apr. 28h	Scheidenhelm and Hammel	395	2,900	5.16	4,520
June 6h	do	412	3,380	7.26	10,600
June 7h	V. F. Hammel	397	2,880	5.62	6,140
July 12l	do	106	132	2.34	358
Aug. 19h	Scheidenhelm and Hammel.	386	2,460	4.06	2,180
Do h	do	385	2,390	3.99	1,950

a Measurement made at original cable section above the present Ice's ferry bridge.

b Measurement made at second cable section about 1 mile below the bridge.

c Mill-race discharge of 25 second-feet included in total discharge of the river.

d Measurement at second cable section about 1 mile below the bridge. Somewhat affected by new Ice's ferry bridge which was erected below the original gage during 1900 to 1901. Mill-race discharge of 6 second-feet included in total discharge of the river.

e Measurement made at wading section, 700 feet above the second cable location. Somewhat affected by new Ice's ferry bridge, which was erected just below the original gage during 1900 to 1901.

f Mill-race discharge of 10 second-feet not included in value of discharge given.

g Measurement at second cable section. Considered inaccurate on account of low velocity, and not used in developing the discharge curve.

h Measurement made at Ice's ferry bridge. Gage height was read on the chain gage and reduced to the corresponding reading on the staff gage.

i Measurement at wading section, three-eighths mile above the bridge.

j Measurement at wading section, one-fourth mile below the cable.

k Measurement at Ice's ferry bridge.

l Measurement at wading section, one-half mile above the bridge. Gage height read on chain gage and reduced to corresponding reading on the staff gage.

NOTE.—Gage heights 1899-1901 refer to original staff gage established July 8, 1899, above the present Ice's ferry bridge. Gage heights 1902-1905 and 1908-9 refer to the staff gage established August 21, 1902, about 1 mile below the bridge, and have been reduced to the present datum. Gage heights of measurements read on the chain gage have been reduced to the corresponding reading on the staff gage. All other gage heights were read directly on the staff gage.

Daily gage height, in feet, of Cheat River near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day	July.	Aug	Sept.	Oct.	Nov.	Dec.
1899							1899						
1	....	3.0	2.2	2.0	3.7	2.9	16	2.8	2.3	2.8	1.7	2.5	3.8
2	....	2.8	2.0	2.0	4.0	2.8	17	3.5	2.4	2.7	1.8	2.4	3.4
3	....	2.7	2.3	1.9	3.8	2.7	18	3.4	2.3	2.3	1.8	2.4	3.2
4	....	2.5	2.2	1.9	3.5	2.7	19	3.0	2.2	2.2	1.7	2.5	3.0
5	....	3.4	2.2	1.9	3.3	2.6	20	2.8	2.1	2.0	1.7	3.4	4.8
6	....	3.3	2.2	1.9	3.1	2.6	21	2.4	2.0	1.9	1.6	3.4	4.4
7	....	3.0	2.1	1.8	2.1	2.5	22	2.4	2.0	1.9	1.6	3.2	4.1
8	2.6	2.8	2.0	1.8	2.1	2.5	23	2.4	1.9	2.3	1.6	3.0	3.9
9	3.0	2.7	2.0	1.8	2.8	2.5	24	2.3	1.9	2.2	1.6	3.0	5.2
10	2.8	2.6	2.2	1.7	2.7	2.5	25	2.5	1.8	2.2	1.6	3.9	4.4

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899							1899						
11	2.7	2.5	4.1	1.7	2.6	2.7	26	2.7	1.8	2.1	1.7	3.7	3.6
12	2.5	2.4	3.8	1.7	2.9	5.5	27	2.8	1.8	2.3	1.7	3.5	3.2
13	2.4	2.3	3.5	1.7	2.7	6.4	28	2.6	2.5	2.4	1.7	3.3	2.9
14	2.5	2.2	3.2	1.7	2.6	4.8	29	2.5	2.4	2.3	1.7	3.1	2.7
15	2.8	2.2	3.0	1.7	2.6	4.2	30	3.5	2.3	2.2	1.7	3.1	2.6
							31	3.6	2.3	....	1.7	....	....
1900							1900						
1	3.2	3.2	2.3	2.1	1.6	....	16	2.6	1.6	1.4	1.4	2.2	3.0
2	2.8	3.1	2.1	2.0	1.6	4.0	17	2.8	1.6	1.4	1.4	2.2	2.9
3	2.7	2.9	2.0	1.9	1.7	4.0	18	2.9	1.5	1.4	1.4	2.1	2.8
4	2.6	2.7	1.9	1.8	1.7	4.3	19	2.9	1.5	1.4	1.5	2.2	2.8
5	2.6	2.6	1.6	1.7	1.6	7.0	20	3.0	1.6	1.4	1.4	3.0	2.7
6	2.4	2.4	1.5	1.6	2.0	7.0	21	3.0	2.0	1.3	1.3	3.3	2.7
7	2.3	2.4	1.4	1.5	2.3	6.0	22	3.0	1.9	1.5	1.3	3.5	2.6
8	3.0	2.3	1.4	1.6	2.5	5.0	23	2.9	1.8	1.5	1.3	3.8	3.0
9	2.9	2.0	1.4	1.7	2.4	4.4	24	3.5	1.8	1.4	2.3	4.0	3.2
10	2.9	2.0	1.4	1.7	2.2	4.7	25	4.8	1.8	1.4	2.3	....	3.3
11	2.8	2.0	1.4	1.7	2.0	3.4	26	5.1	1.8	1.5	2.2	....	3.3
12	2.7	1.8	1.4	1.7	1.9	3.4	27	5.2	1.7	1.3	2.1	....	3.2
13	2.6	1.7	1.3	1.6	1.9	3.2	28	4.9	1.7	1.3	2.0	....	3.1
14	2.5	1.7	1.3	1.5	1.9	3.0	29	3.7	2.0	1.4	1.8	....	3.1
15	2.6	1.7	1.3	1.5	2.0	3.0	30	3.4	2.3	1.4	1.7	....	....
							31	3.2	2.3	....	1.6	....	....

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1902						1902					
1	.....	2.05	3.15	2.85	5.0	16	.....	1.8	3.65	2.55	10.6
2	.....	2.05	5.15	2.55	4.85	17	.....	1.75	3.35	2.55	9.35
3	.....	2.05	4.0	2.55	6.4	18	.....	1.75	3 15	2.55	7.65
4	.....	2.15	3.75	2.55	6.65	19	.....	1.85	3.0	2.35	6.0
5	.....	2.0	3.75	2.4	5.7	20	.....	1.75	2.8	2.35	4.3
6	.....	2.65	3.8	2.25	4.95	21	2.15	1.75	2.8	2.5	4.75
7	.....	2.35	3.4	2.5	4.5	22	2.25	1.65	2.7	2.75	5.55
8	.....	2.2	3.2	2.55	4.45	23	2.95	1.65	2.55	2.7	5.85
9	.....	2.05	2.95	2.75	4.3	24	3.05	1.65	2.55	3.1	5.15
10	.....	2.05	2.7	2.6	3.9	25	2.65	1.65	2.55	4.7	4.65
11	.....	2.05	2.55	2.55	5.95	26	2.4	1.8	2.45	8.15	4.3
12	.....	1.95	5.8	2.55	11.05	27	2.25	2.05	2.55	6.95	3.8
13	.....	1.95	5.3	2.55	10.65	28	2.15	1.95	3.1	5.7	3.55
14	.....	1.85	4.75	2.6	9.1	29	2.05	2.35	2.95	4.9	3.7
15	.....	1.85	4.1	2.55	6.85	30	2.05	2.4	2.95	4.4	5.1
						31	2.05	.....	2.85	.....	4.9

Note.—The temperature was low December 25 to 31, 1899, but the discharge was probably not materially affected by ice conditions.

Note.—The discharge was probably unaffected by ice conditions during December, 1900.

Note.—Discharge unaffected by ice conditions December, 1902.

Daily gage height, in feet, of Cheat River, near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909—Continued.

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.												
1.....	4.3	6.5	10.7	4.05	3.5	3.6	6.0	2.6	2.6	1.75	1.85	2.2
2.....	4.1	6.75	7.1	4.15	3.4	3.3	5.6	3.15	2.55	1.75	1.85	2.2
3.....	10.25	7.5	5.95	4.15	3.35	3.35	4.45	3.05	2.5	1.75	1.85	2.25
4.....	9.05	9.35	5.25	4.4	3.65	3.05	4.0	2.85	2.35	1.75	1.85	2.25
5.....	6.95	8.95	4.9	5.7	3.6	2.85	4.2	2.7	2.15	1.9	1.9	2.15
6.....	5.85	6.6	4.85	4.95	3.4	2.85	4.95	2.45	2.15	2.2	2.1	2.15
7.....	5.15	5.7	5.1	4.8	3.25	3.85	4.3	2.65	2.05	2.2	2.25	2.15
8.....	4.7	5.15	7.25	6.9	3.1	6.0	4.05	2.45	2.05	2.05	2.5	2.1
9.....	3.95	4.95	8.4	8.5	3.05	5.0	3.55	2.45	2.05	3.4	2.4	2.05
10.....	3.65	4.45	6.9	6.7	2.9	4.3	3.3	2.35	2.15	3.45	2.25	2.1
11.....	3.75	4.3	6.05	5.8	2.85	3.95	3.8	2.3	2.15	3.0	2.2	2.15
12.....	6.2	5.4	5.65	5.4	2.85	5.15	4.3	2.25	2.1	2.6	2.15	2.0
13.....	5.25	6.1	5.3	5.3	2.7	7.05	5.1	2.25	2.0	2.45	2.1	2.15
14.....	5.7	5.3	4.95	5.1	2.65	7.15	5.65	2.1	1.95	2.6	2.05	2.6
15.....	5.95	6.0	4.4	4.95	2.6	7.35	4.75	2.1	1.85	2.45	2.05	2.6
16.....	4.45	11.25	4.25	5.85	2.8	6.2	4.05	2.05	1.85	2.35	2.05	2.75
17.....	4.2	8.4	4.15	5.85	2.7	5.1	3.6	2.05	1.85	2.25	2.55	2.55
18.....	3.9	6.45	3.95	5.85	2.6	4.45	3.6	2.05	1.85	2.25	5.6	2.55
19.....	3.55	5.2	3.75	5.3	2.55	4.05	3.55	2.15	2.35	2.4	4.5	2.35
20.....	3.35	5.1	3.6	4.75	2.45	3.85	4.4	2.2	2.9	2.7	3.6	2.45
21.....	3.75	4.5	4.7	4.4	2.4	5.2	4.65	2.15	2.4	2.55	3.1	4.35
22.....	4.15	4.35	5.55	4.25	2.3	4.9	3.8	2.85	2.2	2.45	2.9	4.25
23.....	4.0	3.95	8.1	4.0	2.65	5.0	3.4	2.5	2.05	2.35	2.85	3.8
24.....	3.75	4.15	9.65	3.8	3.85	5.65	3.1	2.3	2.0	2.25	2.75	3.35
25.....	3.65	4.2	6.75	3.9	4.6	4.75	2.85	2.1	1.95	2.15	2.6	4.8
26.....	3.5	4.05	5.7	3.9	5.65	4.05	2.65	2.05	1.85	2.0	2.6	5.7
27.....	3.55	4.3	4.95	4.4	6.65	3.65	2.55	2.05	1.85	2.05	2.4	4.4
28.....	6.4	11.45	4.55	4.15	5.4	4.1	2.35	2.1	1.85	2.05	2.4	3.85
29.....	8.65	....	4.15	3.9	4.65	8.85	2.45	2.1	1.85	2.05	2.25	3.5
30.....	8.9	....	4.05	3.65	4.2	7.7	2.4	2.1	1.75	1.95	2.25	3.5
31.....	8.3	....	4.05	....	3.95	....	2.35	2.6	....	1.95	....	3.2
1904.												
1.....	3.3	3.6	6.55	6.6	6.25	3.4	3.6	2.15	1.8	1.6	2.0	2.0
2.....	3.25	3.0	6.8	6.7	5.85	3.45	4.0	2.25	1.85	1.85	2.0	2.05
3.....	8.75	3.25	7.2	5.95	4.95	3.5	3.65	2.15	1.85	1.9	1.9	2.2
4.....	11.15	3.15	8.35	5.1	5.0	3.9	3.35	2.35	1.85	1.9	1.9	2.1
5.....	11.15	3.0	6.55	4.55	4.55	3.85	3.0	2.55	1.85	1.9	1.9	2.1
6.....	11.15	3.0	5.5	4.3	4.2	4.8	3.0	2.35	1.8	1.85	1.9	2.6
7.....	11.15	4.9	6.1	4.15	3.95	4.3	3.65	2.25	1.75	1.85	1.82	2.5
8.....	11.15	8.65	7.45	4.05	3.75	4.1	3.5	2.3	1.75	1.9	1.8	2.5
9.....	11.15	6.45	6.7	4.05	3.55	3.85	3.4	2.15	1.75	1.8	1.8	2.5
10.....	11.15	5.35	5.7	4.15	3.75	3.7	3.3	2.05	1.75	1.9	1.8	2.4

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11.....	11.15	4.65	5.15	4.0	3.75	3.5	3.55	2.05	1.75	1.95	1.8	2.35
12.....	11.15	4.0	5.05	3.85	3.45	3.3	3.5	2.0	1.75	2.0	1.8	2.2
13.....	11.15	3.6	4.9	3.8	3.3	3.1	3.35	2.05	1.75	2.05	1.8	2.15
14.....	11.15	3.65	4.55	3.85	3.25	2.9	3.05	2.05	1.85	2.75	1.8	2.05
15.....	11.15	3.8	5.15	3.7	3.4	2.85	2.8	2.05	1.85	2.3	1.9	2.15
16.....	11.15	3.4	4.95	3.95	3.7	2.85	2.7	1.95	2.08	2.2	1.95	2.15
17.....	11.15	2.95	4.4	5.05	3.65	2.75	2.55	1.95	1.95	2.15	1.88	2.1
18.....	11.15	3.15	4.35	4.65	3.7	2.9	2.55	1.95	2.02	2.05	1.9	2.2
19.....	11.15	3.0	4.45	4.25	7.2	2.95	2.35	2.0	1.92	2.0	1.9	2.2
20.....	11.15	3.15	4.45	4.0	6.6	2.7	2.3	1.95	1.85	2.0	1.9	2.2
21.....	11.15	3.65	5.1	3.8	6.7	3.25	2.75	2.35	2.2	1.9	2.05	2.15
22.....	21.15	5.7	5.65	3.6	6.55	4.3	3.0	2.1	2.1	2.0	2.1	2.1
23.....	10.95	5.45	8.15	3.45	6.2	4.75	3.25	2.4	1.9	2.0	2.35	2.0
24.....	7.5	6.05	7.85	3.35	4.9	3.45	2.8	2.55	1.85	2.1	2.45	2.6
25.....	5.95	5.4	6.4	3.55	4.45	3.3	2.6	2.55	1.8	2.1	2.4	8.2
26.....	5.05	4.65	5.85	4.7	4.1	2.95	2.45	2.4	1.75	2.0	2.4	7.2
27.....	4.4	4.2	6.0	6.75	4.05	2.85	2.55	2.2	1.75	2.0	2.35	7.2
28.....	3.8	3.95	5.3	7.4	4.15	2.85	2.45	2.05	1.62	2.1	2.05	6.8
29.....	3.75	5.15	4.65	6.5	3.9	3.05	2.5	1.95	1.6	2.0	2.1	5.4
30.....	3.65	....	4.3	6.05	3.7	3.8	2.35	1.85	1.6	2.0	2.0	4.2
31.....	3.6	....	4.35	....	3.55	....	2.2	1.85	....	2.0	....	3.85

Note.—Discharge affected by ice conditions from about January 11 to 27 and about December 14 to 19, 1903, as determined by temperature records. The temperature was very low for a few days about February 18 and 19, 1903, but the discharge was probably not greatly affected by ice conditions owing to the flood which immediately preceded this period.

Note.—Ice gorge from January 3 to 23, 1904. No ice during December on basis of comparison with chain gage heights.

Daily gage heights, in feet, of Cheat River near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909—Continued.

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1.....	3.8	2.95	5.35	4.1	4.4	5.9	3.7	4.05	2.7	2.0	3.55	5.2
2.....	3.6	2.85	4.55	4.0	4.05	5.25	4.15	3.8	2.65	2.0	3.35	4.7
3.....	3.6	2.9	4.1	3.85	3.85	4.4	3.8	3.45	2.5	2.0	3.15	8.25
4.....	3.65	2.85	3.75	3.8	3.7	3.75	3.65	3.05	2.5	2.1	3.1	8.0
5.....	3.45	2.9	3.7	3.8	3.8	3.55	4.75	2.9	2.45	2.05	3.0	6.15
6.....	3.4	2.9	4.7	4.2	4.35	3.4	4.15	3.4	2.4	2.1	3.05	5.1
7.....	3.45	3.1	5.55	4.9	3.95	3.5	3.8	3.2	2.4	2.1	3.4	4.55
8.....	3.35	3.4	8.2	5.05	3.8	3.65	3.8	3.35	2.35	2.1	3.6	4.2
9.....	3.2	3.85	11.25	4.85	3.8	3.45	4.05	3.05	2.3	2.1	3.5	4.0
10.....	3.2	5.95	12.65	4.8	3.55	3.3	3.7	3.15	2.3	2.0	3.45	3.9
11.....	3.3	4.8	8.75	5.8	3.45	3.15	3.65	3.15	2.85	2.0	3.35	3.6
12.....	6.45	4.35	7.05	5.75	7.3	3.65	3.6	3.15	4.15	2.3	3.1	3.55
13.....	9.85	7.4	6.2	4.75	7.45	4.55	3.75	3.0	4.1	3.4	3.0	3.45
14.....	7.05	6.25	5.8	4.6	5.9	4.25	4.45	3.3	3.6	3.2	3.0	3.4
15.....	5.45	8.5	5.4	4.4	8.5	3.6	3.85	5.2	3.05	2.9	2.9	3.3
16.....	4.85	8.3	5.2	4.2	6.75	3.25	3.65	5.6	2.9	2.8	3.0	3.2
17.....	3.95	8.35	5.75	4.05	6.2	3.0	3.45	5.45	2.7	2.55	3.4	3.15
18.....	3.85	7.65	6.05	3.8	5.25	3.0	3.1	4.3	2.65	2.4	3.55	3.1
19.....	3.8	6.7	6.85	3.7	4.8	3.0	2.9	4.0	2.5	2.45	3.4	3.2
20.....	3.8	6.55	8.2	3.7	4.45	3.0	3.8	3.5	2.45	6.6	3.35	3.2
21.....	3.8	6.55	10.85	4.6	4.1	3.05	4.3	3.45	2.4	6.0	3.05	5.1
22.....	3.6	7.0	9.35	5.65	3.85	5.3	3.7	3.05	2.3	5.2	2.8	5.85
23.....	3.5	8.0	7.25	5.35	3.55	5.25	3.8	2.9	2.3	4.65	2.65	5.95
24.....	3.4	7.9	6.1	4.65	3.5	4.85	5.5	2.75	2.25	3.25	2.45	6.05
25.....	3.2	7.5	6.65	4.35	3.3	5.9	4.35	4.35	2.2	3.1	3.3	4.95
26.....	2.8	7.85	6.55	4.95	3.2	5.0	3.7	5.25	2.1	4.15	3.3	4.15
27.....	2.95	7.25	6.05	4.35	3.1	6.9	3.55	4.25	2.1	5.25	3.3	4.2
28.....	2.9	6.3	5.6	5.9	3.0	5.45	3.25	3.75	2.1	4.55	3.3	4.0
29.....	2.95	....	5.1	5.4	3.0	4.5	3.2	3.55	2.0	3.9	5.1	4.15
30.....	3.0	....	4.85	4.95	2.95	3.9	5.15	2.9	2.0	3.8	7.3	4.25
31.....	3.15	....	4.65	....	3.2	....	4.6	2.9	....	3.65	....	4.15

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	1.71	11	.....	2.00	21	1.61	3.40
2	.....	1.71	12	.....	2.32	22	1.61	2.78
3	.....	1.66	13	.....	3.05	23	1.74	2.60
4	.....	1.66	14	.....	2.90	24	1.81	2.57
5	.....	1.66	15	.....	2.65	25	1.81	2.50
6	.....	1.66	16	.....	2.35	26	1.81	2.32
7	.....	1.66	17	.....	2.44	27	1.76	2.35
8	.....	1.86	18	1.61	2.70	28	1.76	2.40
9	.....	1.86	19	1.61	4.65	29	1.71	2.42
10	.....	1.99	20	1.61	4.00	30	1.71	2.40
						31	.....	2.35

Day.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1.....	3.44	3.20	5.00	4.50	5.41	3.14	3.56	5.30	3.12	2.67	3.37	3.16
2.....	2.98	3.10	4.73	4.39	6.36	5.08	3.50	4.24	2.86	2.60	3.40	3.09
3.....	2.82	3.20	5.36	5.10	6.57	5.18	3.38	3.75	2.75	2.56	3.21	3.00
4.....	2.68	3.35	6.68	5.44	5.38	4.49	3.06	3.34	2.80	2.45	3.14	2.91
5.....	2.70	3.62	5.63	5.71	5.25	5.66	2.87	3.11	2.92	2.43	3.11	2.87
6.....	2.78	4.95	5.08	6.08	4.84	7.21	2.75	2.97	2.87	2.36	3.01	2.85
7.....	3.65	5.25	4.90	5.97	4.43	5.82	2.64	2.87	2.91	2.29	3.09	2.80
8.....	3.56	4.80	5.90	5.38	4.14	5.14	2.54	2.80	2.76	2.26	2.86	3.27
9.....	3.08	4.30	5.95	4.53	3.98	7.02	2.54	2.70	2.68	2.24	3.03	3.04
10.....	3.18	5.96	6.92	4.47	3.89	6.20	2.52	2.61	2.65	2.21	3.05	2.87
11.....	3.10	6.90	6.66	4.20	3.68	7.68	2.43	2.54	6.00	2.24	4.82	2.82
12.....	3.13	5.45	6.54	4.12	4.11	6.57	2.34	2.50	4.45	2.82	4.32	2.75
13.....	3.45	5.00	4.98	4.20	3.75	5.29	2.41	2.42	3.70	4.66	3.98	2.94
14.....	3.47	5.50	4.80	8.28	3.56	5.15	2.49	2.32	3.25	3.72	3.70	5.59
15.....	8.75	5.50	5.07	8.04	3.40	5.35	2.45	2.52	3.06	3.32	3.53	5.46
16.....	7.40	7.20	4.56	6.22	3.28	5.11	2.68	3.98	5.43	3.42	3.36	4.57
17.....	5.75	7.12	4.30	5.33	3.14	4.80	2.50	5.35	5.00	3.53	3.24	3.98
18.....	4.80	5.94	4.14	4.78	3.03	6.94	2.39	4.57	4.06	3.38	3.19	3.95
19.....	4.05	5.16	3.94	4.40	2.99	6.13	2.36	3.95	3.45	3.36	3.20	3.74
20.....	4.00	5.20	4.12	4.36	2.89	5.07	2.31	3.61	3.11	4.09	3.11	3.65
21.....	4.13	5.73	4.18	7.09	2.86	4.38	2.28	4.16	2.92	3.92	3.01	3.23
22.....	4.37	5.40	4.02	9.06	3.06	4.00	2.26	3.37	2.82	3.71	3.01	2.91
23.....	4.58	5.47	3.83	7.84	4.19	3.86	2.34	3.19	2.73	4.00	3.04	2.65
24.....	5.80	7.95	3.68	7.50	3.60	3.72	2.41	2.99	2.87	9.16	3.11	....
25.....	5.40	7.58	3.86	6.32	3.40	3.45	3.41	2.83	4.16	6.59	....	2.77
26.....	4.80	6.30	4.58	5.71	3.24	3.29	3.11	2.68	3.64	5.37	3.53	2.65
27.....	4.40	5.64	5.27	5.46	3.38	3.16	2.77	2.63	3.21	4.71	3.37	2.87
28.....	3.85	5.34	5.18	5.18	3.98	3.49	2.63	2.54	3.07	4.24	3.19	2.83
29.....	3.60	....	5.48	5.00	4.00	4.19	2.58	2.68	2.87	3.88	3.11	2.68
30.....	3.80	....	5.07	4.90	3.56	3.95	2.63	3.70	2.77	3.72	3.06	2.61
31.....	3.45	....	4.78	....	3.34	....	8.53	3.51	....	3.49	....	2.45

Note.—High gage heights February 13 to about March 3 caused by backwater from ice gorge. Ice conditions probably prevailed from about January 27 to March 3. No ice during December on the basis of comparison with chain gage heights.

Note.—Discharge unaffected by ice conditions during December, 1908.

Note.—Discharge probably unaffected by ice conditions January to March, 1909. Discharge about December 10 to 13 and 18 to 31, 1909, affected by ice conditions.

Rating tables for Cheat River near Morgantown, W. Va.

1899 and 1900 (Referred to first staff gage).

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.30	165	2.50	970	3.70	3.500	4.90	7.790
1.40	200	2.60	1,100	3.80	3,820	5.00	8,180
1.50	240	2.70	1,240	3.90	4,150	5.20	8,970
1.60	280	2.80	1,400	4.00	4.490	5.40	9,770
1.70	325	2.90	1,570	4.10	4,830	5.60	10,570
1.80	375	3.00	1,750	4.20	5,180	5.80	11,380
1.90	430	3.10	1,940	4.30	5,540	6.00	12,200
2.00	495	3.20	2,150	4.40	5,900	6.20	13,020
2.10	570	3.30	2,380	4.50	6,270	6.40	13,840
2.20	655	3.40	2,630	4.60	6,640	6.60	14,670
2.30	750	3.50	2,900	4.70	7.020	6.80	15,510
2.40	855	3.60	3,190	4.80	7,400	7.00	16,350

Note.—The above table is not applicable for ice or obstructed-channel conditions. It is based on four discharge measurements made 1899-1901 and is fairly well defined. Above gage height 3.0 feet the rating curve is based on the form of the rating referred to the chain gage at Ice's ferry bridge and should be accurate. This table applies to original gage located about 100 feet above the present Ice's ferry bridge.

1902 to 1909. (Referred to second staff gage.)

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.	Feet.	Sec.-ft.
1.50	110	2.90	735	4.30	2,670	6.40	8,210
1.60	135	3.00	815	4.40	2,880	6.60	8,830
1.70	160	3.10	905	4.50	3,090	6.80	9,450
1.80	190	3.20	1.005	4.60	3,310	7.00	10,080
1.90	220	3.30	1,110	4.70	3,530	7.20	10,720
2.00	255	3.40	1,220	4.80	3,760	7.40	11,370
2.10	290	3.50	1,340	4.90	4,000	7.60	12,030
2.20	330	3.60	1,470	5.00	4,250	7.80	12,690
2.30	375	3.70	1,610	5.20	4,760	8.00	13,370
2.40	420	3.80	1,760	5.40	5,300	9.00	16,830
2.50	470	3.90	1 920	5.60	5,860	10.00	20,430
2.60	525	4.00	2,090	5.80	6,430	11.00	24,180
2.70	590	4.10	2,280	6.00	7,010	12.00	27,980
2.80	660	4.20	2,470	6.20	7,610	13.00	31,880

Note.—The above table is not applicable for ice or obstructed-channel conditions. It is based on thirteen discharge measurements made during 1902 to 1909 and is well defined between gage heights, 1.6

Daily discharge, in second-feet, of Cheat River near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1899							1899						
1	....	1,750	655	495	3,500	1,570	16	1,400	750	1,400	325	970	3,820
2	....	1,400	495	495	4,490	1,400	17	2,900	855	1,240	375	855	2,630
3	....	1,240	750	430	3,820	1,240	18	2,630	750	750	375	855	2,150
4	....	970	655	430	2,900	1,240	19	1,750	655	655	325	970	1,750
5	....	2,630	655	430	2,380	1,100	20	1,400	570	495	325	2,630	7,400
6	....	2,380	655	430	1,940	1,100	21	855	495	430	280	2,630	5,900
7	....	1,750	570	375	570	970	22	855	495	430	280	2,150	4,830
8	1,100	1,400	495	375	570	970	23	855	430	750	280	1,750	4,150
9	1,750	1,240	495	375	1,400	970	24	750	430	655	280	1,750	8,970
10	1,400	1,100	655	325	1,240	970	25	970	375	655	280	4,150	5,900
11	1,240	970	4,830	325	1,100	1,240	26	1,240	375	570	325	3,500	3,190
12	970	855	3,820	325	1,570	16,200	27	1,400	375	750	325	2,900	2,150
13	855	750	2,900	325	1,240	13,800	28	1,100	970	855	325	2,380	1,570
14	970	655	2,150	325	1,100	7,400	29	970	855	750	325	1,940	1,240
15	1,400	655	1,750	325	1,100	5,180	30	2,900	750	655	325	1,940	1,100
							31	3,190	750	....	325	....	970

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1900							1900						
1	2,150	2,150	750	570	280	6,270	16	1,100	280	200	200	655	1,750
2	1,400	1,940	570	495	280	4,490	17	1,400	280	200	200	655	1,570
3	1,240	1,570	495	430	325	4,490	18	1,570	240	200	200	570	1,400
4	1,100	1,240	430	375	325	5,540	19	1,570	240	200	240	655	1,400
5	1,100	1,100	280	325	280	16,400	20	1,750	280	200	200	1,750	1,240
6	855	855	240	280	495	16,400	21	1,750	495	165	165	2,380	1,240
7	750	855	200	240	750	12,200	22	1,750	430	240	165	2,900	1,100
8	1,750	750	200	280	970	8,180	23	1,570	375	240	165	3,820	1,750
9	1,570	495	200	325	855	5,900	24	2,900	375	200	750	4,490	2,150
10	1,570	495	200	325	655	7,020	25	7,400	375	200	750	8,180	2,380
11	1,400	495	200	325	495	2,630	26	8,570	375	240	655	14,000	2,380
12	1,240	375	200	325	430	2,630	27	8,970	325	165	570	20,000	2,150
13	1,100	325	165	280	430	2,150	28	7,790	325	165	495	13,800	1,940
14	970	325	165	240	430	1,750	29	3,500	495	200	375	9,770	1,940
15	1,100	825	165	240	495	1,750	30	2,630	750	200	325	8,180	2,900
							31	2,150	750	....	280	.....	2,900

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1902						1902					
1	.....	272	955	698	4,250	16	.....	190	1,540	498	22,700
2	.....	272	4,630	498	3,880	17	.....	175	1,160	498	18,100
3	.....	272	2,090	498	8,210	18	.....	175	955	498	12,200
4	.....	310	1,680	498	8,980	19	.....	205	815	398	7,010
5	.....	255	1,680	420	6,140	20	.....	175	660	398	2,670
6	.....	558	1,760	352	4,120	21	310	175	660	470	3,640
7	.....	398	1,220	470	3,090	22	352	148	590	625	5,720
8	.....	330	1,000	498	2,980	23	775	148	498	590	6,580
9	.....	272	775	625	2,670	24	860	148	498	905	4,630
10	.....	272	590	525	1,920	25	558	148	498	3,530	3,420
11	.....	272	498	498	6,860	26	420	190	445	13,900	2,670
12	.....	238	6,430	498	24,400	27	352	272	498	9,920	1,760
13	.....	238	5,030	498	22,800	28	310	238	905	6,140	1,400
14	.....	205	3,640	525	17,200	29	272	398	775	4,000	1,610
15	.....	205	2,280	498	9,600	30	272	420	775	2,880	4,500
						31	272	.....	698	.....	4,000

Note.—Discharge estimated December 31, 1899.

Note.—Discharges November 25 to December 1 and December 30 and 31, 1900, estimated by a hydrograph comparison with Youghiogheny River at Friendsville, Md.

Daily discharge in second-feet, of Cheat River near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909—Continued.

Day.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1903												
1	2,670	8,520	23,000	2,180	1,340	1,470	7,010	525	525	175	205	330
2	2,280	9,300	10,400	2,380	1,220	1,110	5,860	955	498	175	205	330
3	21,400	11,760	6,860	2,380	1,160	1,160	2,980	860	470	175	205	352
4	17,000	18,100	4,900	2,880	1,540	860	2,090	698	398	175	205	352
5	9,920	16,700	4,000	6,140	1,470	698	2,470	590	310	220	220	310
6	6,580	8,830	3,880	4,120	1,220	698	4,120	445	310	330	290	310
7	4,630	6,140	4,500	3,760	1,060	1,840	2,670	558	272	330	352	310
8	3,530	4,630	10,900	9,760	905	7,010	2,180	445	272	272	470	290
9	2,000	4,120	14,700	15,100	860	4,250	1,400	445	272	1,220	420	272
10	1,540	2,980	9,760	9,140	735	2,670	1,110	398	310	1,280	352	290
11	1,200	2,670	7,160	6,430	698	2,000	1,760	375	310	815	330	310
12	1,000	5,300	6,000	5,300	698	4,630	2,670	352	290	525	310	255
13	700	7,310	5,030	5,030	590	10,200	4,500	352	255	445	290	310
14	500	5,030	4,120	4,500	558	10,600	6,000	290	238	525	272	250
15	400	7,010	2,880	4,120	525	11,200	3,640	290	205	445	272	250
16	500	25,100	2,570	6,580	660	7,610	2,180	272	205	398	272	200
17	700	14,700	2,380	6,580	590	4,590	1,470	272	205	352	498	200
18	700	8,360	2,000	6,580	525	2,980	1,470	272	205	352	5,860	200
19	500	4,760	1,680	5,030	498	2,180	1,400	310	398	420	3,090	250
20	700	4,500	1,470	3,640	445	1,840	2,880	330	735	590	1,470	445
21	800	3,690	3,530	2,880	420	4,760	3,420	310	420	498	905	2,780
22	700	2,780	5,720	2,570	375	4,000	1,760	698	330	445	735	2,570
23	700	2,000	13,700	2,090	558	4,250	1,220	470	272	398	698	1,760
24	600	2,380	19,200	1,760	1,840	6,000	905	375	255	352	625	1,160
25	700	2,470	9,300	1,920	3,310	3,640	698	290	238	310	525	3,760
26	800	2,180	6,140	1,920	6,000	2,180	558	272	205	255	525	6,140
27	1,000	2,670	4,120	2,880	8,980	1,540	498	272	205	272	420	2,880
28	8,210	25,900	3,200	2,380	5,300	2,280	398	290	205	272	420	1,840
29	15,600	.....	2,380	1,920	3,420	16,300	445	290	205	272	352	1,340
30	16,500	.....	2,180	1,540	2,470	12,400	420	290	175	238	352	1,340
31	14,400	.....	2,180	.....	2,000	.....	398	525	.....	238	.....	1,000
1904												
1	1,110	1,470	8,680	8,830	7,760	1,220	1,470	310	190	135	255	225
2	1,060	815	9,450	9,140	6,580	1,280	2,090	352	205	205	255	272
3	4,000	1,060	10,700	6,860	4,120	1,340	1,540	310	205	220	220	330
4	1,800	955	14,600	4,500	4,250	1,920	1,160	398	205	220	220	290
5	1,400	815	8,680	3,200	3,200	1,840	815	498	205	220	220	290
6	1,000	815	5,580	2,670	2,470	3,760	815	398	190	205	220	525
7	900	4,000	7,310	2,380	2,000	2,670	1,540	352	175	205	196	470
8	800	15,600	11,500	2,180	1,680	2,280	1,340	375	175	220	190	470
9	800	8,360	9,140	2,180	1,400	1,840	1,220	310	175	190	190	470
10	800	5,160	6,140	2,380	1,680	1,610	1,110	272	175	220	190	420
11	800	3,420	4,630	2,090	1,680	1,340	1,400	272	175	238	190	398
12	800	2,090	4,380	1,840	1,280	1,110	1,340	255	175	255	190	330
13	800	1,470	4,000	1,760	1,110	905	1,160	272	175	272	190	310
14	800	1,540	3,200	1,840	1,060	735	860	272	205	625	190	272
15	800	1,760	4,630	1,610	1,220	698	660	272	205	375	220	310
16	800	1,220	4,120	2,000	1,610	698	590	238	283	330	238	310
17	800	775	2,880	4,380	1,540	625	498	238	238	310	214	290
18	900	955	2,780	3,420	1,610	735	498	238	262	272	220	330
19	1,200	815	2,980	2,570	10,700	775	398	255	227	255	220	330
20	4,000	955	2,980	2,090	8,830	590	375	238	205	255	220	330

Day.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904												
21	9,600	1,540	4,500	1,760	9,140	1,060	625	398	330	220	272	310
22	15,000	6,140	6,000	1,470	8,680	2,670	815	290	290	255	290	290
23	21,000	5,430	13,900	1,280	7,610	3,640	1,060	420	220	255	398	255
24	11,700	7,160	12,900	1,160	4,000	1,280	660	498	205	290	445	525
25	6,860	5,300	8,210	1,400	2,980	1,110	525	498	190	290	420	14,000
26	4,380	3,420	6,580	3,530	2,280	775	445	420	175	255	420	10,700
27	2,880	2,470	7,010	9,300	2,480	698	498	330	175	255	398	10,760
28	1,760	2,000	5,030	11,400	2,380	698	445	272	140	290	272	9,450
29	1,680	4,630	3,420	8,520	1,920	860	470	238	135	255	290	5,300
30	1,540	.....	2,670	7,160	1,610	1,760	398	205	135	255	255	2,470
31	1,470	.....	2,780	.....	1,400	.....	330	205	.....	255	.....	1,840

Note.—Discharges January 11 to 27 and December 14 to 19, 1903, estimated on the basis of climatological reports on temperature and precipitation.

Note.—Discharge estimated for ice period, January 3 to 23, 1904, on the basis of climatological reports and a thorough study of run-off conditions during the period.

Day.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1905												
1	1,760	450	1,500	2,280	2,880	6,720	1,610	2,180	590	255	1,400	4,760
2	1,470	450	1,500	2,090	2,180	4,900	2,380	1,760	558	255	1,160	3,530
3	1,470	450	1,500	1,840	1,840	2,880	1,760	1,280	470	255	955	14,200
4	1,540	450	1,680	1,760	1,610	1,680	1,540	860	470	290	905	13,400
5	1,280	450	1,610	1,760	1,760	1,400	3,640	735	445	272	815	7,460
6	1,220	500	3,530	2,470	2,780	1,220	2,380	1,220	420	290	860	4,500
7	1,280	750	5,720	4,900	2,000	1,340	1,760	1,000	420	290	1,220	3,200
8	1,160	1,000	14,000	4,380	1,760	1,540	1,760	1,160	398	290	1,470	2,470
9	1,000	1,200	25,100	3,880	1,760	1,280	2,180	860	375	290	1,340	2,090
10	1,000	4,500	30,400	3,760	1,400	1,110	1,610	955	375	255	1,280	1,920
11	1,110	2,500	16,000	6,430	1,280	955	1,540	955	698	255	1,160	1,470
12	8,360	1,560	10,200	6,280	11,000	1,540	1,470	955	2,380	375	905	1,400
13	19,900	2,500	7,610	3,640	11,500	3,200	1,680	815	2,280	1,220	815	1,280
14	10,200	1,500	5,430	3,310	6,720	2,570	2,980	1,110	1,470	1,000	815	1,220
15	5,440	1,000	5,300	2,880	15,100	1,470	1,840	4,760	860	735	735	1 110
16	3,880	700	4,760	2,470	9,300	1,060	1,540	5,860	735	660	815	1,000
17	2,000	600	6,280	2,180	7,610	815	1,280	5,440	590	498	1,220	955
18	1,840	500	7,160	1,760	4,300	815	905	2,670	558	420	1,400	995
19	1,760	560	9,660	1,610	3,760	815	735	2,090	470	445	1,220	1,000
20	1,760	600	14,000	1,610	2,980	815	1,760	1,340	445	8,830	1,160	1,000
21	1,760	700	23,600	3,310	2,280	860	2,670	1,280	420	7,010	860	4,500
22	1,470	700	18,100	6,000	1,840	5,030	1,610	860	375	4,760	660	6,580
23	1,340	800	10,900	5,160	1,400	4,900	1,760	735	375	3,420	558	6,860
24	1,220	800	7,310	3,420	1,340	3,880	5,580	625	352	1,060	445	7,160
25	1,000	800	8,980	2,780	1,110	6,720	2,780	2,780	330	905	1,110	4,120
26	660	1,800	8,680	2,180	1,000	4,250	1,610	4,900	290	2,380	1,110	2,380
27	600	1,500	7,160	2,780	905	9,760	1,400	2,570	290	4,900	1,110	2,470
28	550	1,500	5,860	6,720	815	5,440	1,060	1,680	290	3,200	1,110	2,090
29	500	.....	4,500	5,300	815	3,090	1,000	1,400	255	1,920	4,500	2,380
30	500	.....	3,880	4,120	775	1,920	4,630	735	255	1,760	11,000	2,570
31	450	.....	3,420	.....	1,000	.....	3,310	735	.....	1,540	.....	2,380

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908			1908			1908		
1	....	163	11	....	255	21	138	1,220
2	....	163	12	....	384	22	138	646
3	....	150	13	....	860	23	172	525
4	....	150	14	....	735	24	193	508
5	....	150	15	....	558	25	193	470
6	....	150	16	....	398	26	193	384
7	....	150	17	....	440	27	178	398
8	....	208	18	138	590	28	178	420
9	....	208	19	138	3,420	29	163	430
10	....	252	20	138	2,090	30	163	420
						31	....	398

Day.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1909												
1	1,270	1,000	4,250	3,090	5,410	945	1,420	5,030	925	570	1,190	965
2	799	905	3,600	2,860	8,090	4,450	1,340	2,550	705	525	1,220	896
3	675	1,000	5,190	4,500	8,740	4,710	1,200	1,680	625	503	1,020	815
4	577	1,160	9,080	5,410	5,250	3,070	869	1,150	660	445	945	743
5	590	1,500	5,940	6,170	4,900	6,030	712	915	751	435	915	712
6	646	4,120	4,450	7,250	3,860	10,800	625	791	712	402	824	698
7	1,540	4,900	4,000	6,920	2,940	6,490	551	712	743	370	896	660
8	1,420	3,760	6,720	5,250	2,360	4,600	492	660	632	357	705	1,080
9	887	2,670	6,860	3,160	2,060	10,100	492	590	577	348	842	851
10	985	6,890	9,820	3,030	1,900	7,610	481	532	558	334	860	650
11	905	9,760	9,020	2,470	1,580	12,300	435	492	7,010	348	3,810	600
12	935	5,440	5,690	2,320	2,300	8,740	393	470	2,980	675	2,710	550
13	1,280	4,250	4,200	2,470	1,680	5,000	425	430	1,610	3,440	2,060	700
14	1,300	5,580	3,760	14,300	1,420	4,630	465	384	1,060	1,640	1,610	5,830
15	16,000	5,580	4,420	13,500	1,220	5,160	445	481	869	1,130	1,380	5,470
16	11,400	10,700	3,220	7,670	1,090	4,530	577	2,060	5,380	1,240	1,180	3,240
17	6,280	10,500	2,670	5,110	945	3,760	470	5,160	4,250	1,380	1,050	2,060
18	3,760	6,840	2,360	3,710	842	9,890	416	3,240	2,200	1,200	995	1,500
19	2,180	4,660	1,990	2,880	807	7,400	402	2,000	1,280	1,180	1,000	1,200
20	2,090	4,760	2,320	2,800	728	4,420	380	1,480	915	2,260	915	1,000
21	2,340	6,230	2,430	10,400	705	2,840	366	2,390	751	1,950	824	800
22	2,820	5,300	2,130	17,000	869	2,090	357	1,190	675	1,620	824	500
23	3,270	5,500	1,810	12,800	2,450	1,860	393	995	611	2,090	851	450
24	6,430	13,200	1,580	11,700	1,470	1,640	425	807	712	17,400	915	450
25	5,300	12,000	1,860	7,970	1,220	1,280	1,230	682	2,390	8,800	1,140	450
26	3,760	7,910	3,270	6,170	1,050	1,100	915	577	1,530	5,220	1,380	400
27	2,880	5,970	4,950	5,470	1,200	965	639	544	1,020	3,550	1,190	450
28	1,840	5,140	4,710	4,710	2,060	1,330	544	492	878	2,550	995	400
29	1,470	.....	5,520	4,250	2,090	2,450	514	577	712	1,890	915	350
30	1,760	.....	4,420	4,000	1,420	2,000	544	1,610	639	1,640	869	300
31	1,280	.....	3,710	.....	1,150	.....	15,200	1,350	.....	1,330	.....	250

Note.—Discharges January 27 to March 3, 1905, estimated on basis of climatological reports.

Note.—Discharge December 10 to 13 and 18 to 31, 1909, estimated on the basis of climatological data.

Monthly discharge of Cheat River near Morgantown, W. Va., for 1899, 1900, 1902 to 1905, 1908, and 1909.

(Drainage area, 1,380 square miles).

Month	Discharge in second-feet.				Run-off (depth in inches on drainage area)	Accuracy
	Maximum	Minimum	Mean	Per square mile		
1899						
July 8-31	3,190	750	1,450	1.05	0.94	A.
August	2,630	375	940	.681	.79	B.
September	4,830	430	1,090	.790	.88	B.
October	495	280	350	.254	.29	B.
November	4,490	570	2,010	1.46	1.63	A.
December	13,800	970	3,420	2.48	2.86	A.
1900						
July	8,970	750	2,440	1.77	2.04	A.
August	2,150	240	635	.460	.53	B.
September	750	165	249	.180	.20	B.
October	750	165	348	.252	.29	B.
November	a20,000	280	3,310	2.40	2.68	B.
December	16,400	1,100	4,130	2.99	3.45	A.
1902						
August 21-31	860	272	432	.313	.13	A.
September	558	148	252	.183	.20	A.
October	6,430	445	1,490	1.08	1.24	A.
November	13,900	352	1,760	1.28	1.43	A.
December	24,400	1,400	7,410	5.37	6.19	A.
1903						
January b	21,400	400	4,470	3.24	3.74	C.
February	25,900	2,000	7,830	5.67	5.90	A.
March	23,000	1,470	6,450	4.67	5.38	A.
April	15,100	1,540	4,450	3.22	1.41	A.
May	8,980	375	1,680	1.22	1.41	A.
June	16,300	698	4,560	3.30	3.68	A.
July	7,010	398	2,280	1.65	1.90	A.
August	955	272	423	.307	.35	A.
September	735	175	306	.222	.25	A.
October	1,280	175	412	.299	.34	A.
November	5,860	205	705	.511	.57	A.
December b	6,140	200	1,040	.753	.87	A.
The year	25,900	175	2,880	2.09	27.98	

a Estimated from hydrograph comparison of this station with Youghiogheny River at Friendsville, Md.

b Ice conditions January 11 to 27, and December 14 to 19, 1903; discharge estimated.

Month	Discharge in second-feet.				Run-off (depth in inches on drainage area)	Accuracy
	Maximum	Minimum	Mean	Per square mile		
1904						
January a...	21,000	800	3,330	2.41	2.78	C.
February ...	15,600	775	3,180	2.30	2.48	A.
March	14,600	2,670	6,500	4.71	5.43	A.
April	11,400	1,160	3,830	2.78	3.10	A.
May	10,700	1,060	3,550	2.57	2.96	A.
June	3,760	590	1,420	1.03	1.15	A.
July	2,090	330	876	.635	.73	A.
August	498	205	319	.231	.27	A.
September .	330	135	202	.146	.16	A.
October ...	625	135	261	.189	.22	A.
November ..	445	190	257	.186	.21	A.
December ..	14,000	255	2,030	1.47	1.70	A.
The year..	21,000	135	2,150	1.55	21.19	
1905						
January a...	19,900	450	2,560	1.86	2.14	A.
February a..	4,500	450	1,090	.790	.82	D.
March a....	30,400	1,500	8,910	6.46	7.45	A.
April	6,720	1,610	3,410	2.47	2.76	A.
May	15,100	775	3,460	2.51	2.89	A.
June	9,760	815	2,800	2.03	2.26	A.
July	5,580	735	2,060	1.49	1.72	A.
August	5,860	625	1,820	1.32	1.52	A.
September .	2,380	255	608	.441	.49	A.
October	8,830	255	1,610	1.17	1.35	A.
November ..	11,000	445	1,470	1.07	1.19	A.
December ..	14,200	905	3,620	2.62	3.02	A.
The year..	30,400	255	2,780	2.02	27.61	
1908						
Nov. 18-30..	193	138	163	.118	.06	A.
December ..	3,420	150	558	.404	.47	A.
1909						
January	16,000	577	2,860	2.07	2.39	A.
February ...	13,200	905	5,620	4.07	4.24	A.
March	9,820	1,580	4,390	3.18	3.67	A.
April	17,000	2,320	6,310	4.57	5.10	A.
May	8,740	705	2,380	1.72	1.98	A.
June	12,300	945	4,740	3.43	3.83	A.
July	15,200	357	1,090	.790	.91	A.
August	5,160	384	1,360	.986	1.14	A.
September .	7,010	558	1,480	1.07	1.19	A.
October ...	17,400	334	2,160	1.57	1.81	A.
November .	3,810	705	1,200	.870	.97	A.
December b	5,830	.....	1,130	.819	.94	C.
The year..	17,400	.....	2,890	2.10	28.17	

a Ice conditions January 3 to 23, 1904, and January 27 to March 3, 1905; discharge estimated.

b Ice conditions December 10 to 13 and 18 to 31, 1909; discharge estimated.

The value of such data in estimating the available water power of any stream can hardly be overestimated; hence, the elaborate results obtained at this gaging station are republished in full, since they give invaluable information regarding one of Monongalia county's greatest and most economic resources.

What appears to be an old, abandoned channel of Cheat occurs a mile and a third north of the Ice's Ferry bridge, where the river seems to have made a loop to the northward around the dome-shaped hill and later cut through the neck of the peninsula thus formed.

Remnants of the old shore line of an ancient lake formed during glacial time in the shape of rounded boulders and gravel in profusion occur along the valley walls of Cheat in Monongalia, at elevations ranging from 950′ to over 1000′ A. T. One place in particular is along the hill road on the west bank of the river, leading south and westward from the Ice's Ferry bridge. These terrace boulder deposits were made while the Glacial Ice movement blocked the northward course of the Monongahela across Ohio to the St. Lawrence basin.

Dunkard Creek.—Dunkard creek drains the larger portion of Battelle and Clay districts, Monongalia county, and empties into the Monongahela 3 miles northward from the State line. The total area of its drainage basin, and of that portion included in Monongalia, are given in the table on a preceding page of this chapter. It has its head in the extreme northwestern corner of the latter county, and flows eastward with a widely meandering channel in its lower course via Jollytown, Brave, Blacksville, Mt. Morris and Dunkard. The table on page 43, gives some interesting data concerning the rate of fall in different parts of its channel. It shows that the rate is much lower in the 20.4 miles of its course between Shamrock and Mt. Morris, than in the lower 12.2 miles of its course between Mt. Morris and the river. This exceptional feature is due to the youthful character of the stream below its pre-glacial terrace and also to the hardness of the strata brought to the surface by the sharp dip to the northwest in the latter part of its course. It evidently possesses its mature character, as exhibited by its widely meandering channel.

by inheritance, since it has yet a large amount of erosion to accomplish to attain base level with the Monongahela.

Deckers Creek.---Deckers creek drains much the greater portion of Morgan district, Monongalia county, and empties into the Monongahela at Morgantown. The area of its drainage basin is 63.8 miles (map measurement). It has its head in central Preston county, at an elevation of over 2000′ A. T., and flows northwestward, falling to 793.4′ A. T., at Morgantown. The table on a preceding page of this chapter gives some interesting data concerning the rate of fall in different parts of its course. It is the writer's belief that Cobun creek once flowed into Deckers creek via Aaron creek through the low gap located just east of Kingwood pike, about a mile and a half southeastward from the mouth of the former. Later the advancing headwaters of a stream occupying the present lower course of Cobun finally captured the latter creek. Still another noteworthy topographic feature is connected with Cobun creek near its mouth where it has cut through the neck of the peninsula formed by one of its loops to the west, and left standing an isolated and dome-shaped hill.

Buffalo Creek.—Buffalo creek has its head in the extreme northwestern corner of Marion county at an elevation of 1300′ A. T., and flows southeastward, emptying into the Monongahela river one mile below Fairmont. It drains the larger portion of Mannington, Lincoln and Fairmont districts, and the area of its drainage basin is 125 square miles. The table on a preceding page of this chapter gives interesting data on the rate of fall in different parts of its course. It shows that this stream is still in the period of youth, and that its mature character, as exhibited by its widely meandering channel below Mannington, is one of inheritance from pre-glacial times.

Between Mannington and Downs there occurs what seems to be an old abandoned channel of this creek, part of which is at present occupied by Mahan run in the last half mile of its course. Here, Buffalo evidently once made a loop to the northward around the dome-shaped hill and later cut its present channel through the neck of the peninsula formed.

What appears to be a typical case of stream piracy ap-

pears to have occurred three-fourths mile southward from Downs. It seems quite probable that Grays run once emptied into Buffalo almost a mile further down stream through the low gap 0.6 mile southeast of Downs station, but was later beheaded by the ever advancing divide of a stream, the channel of which is now used by Grays run in the last half mile of its course.

Threeforks Creek.—Threeforks creek empties into Tygart Valley river at Grafton, and drains a large part of the eastern half of Taylor county. It has its head near the summit of Chestnut Ridge in Clinton district, Monongalia county, 3 miles eastward from Ridgedale, and flows south and westward via Irondale and Thornton. The area of its drainage basin is 103 square miles (map measurement). The table on a preceding page of this chapter gives interesting data as to the rate of fall in different parts of its course. The results therein expressed show that it is still in the period of youth, that a great work of erosion remains yet to be accomplished before it attains base level with Tygart Valley river.

TOPOGRAPHY OF THE LAND AREA.

The topography of the Monongalia-Marion-Taylor area, as with other counties in the western portion of the State, is that of a highly dissected plateau, ranging in elevation from 1500 to over 2000 feet above sea level. Erosive agents have reduced this plateau practically all to slope, the streams generally flowing in narrow, deeply indented "V" shaped valleys, with comparatively sharp and narrow divides between. The several ridges and knobs therein, capped with more resistant layers of hard strata, remain as mute testimony of this plateau's former existence.

The Monongahela river and its large tributaries—Cheat, Tygart Valley and West Fork rivers—have eroded deep gorges in this plateau from ¼ to ¾ mile in width and from 600 to 1350 feet in depth, through nearly horizontal and parallel layers of rock. The valley walls are often quite precipitous,

and especially is this true in the great gorge of Cheat river from Ice's Ferry bridge southeastward to the Preston county line.

River and Lake Terraces.

As mentioned on a preceding page, there occur a series of high erosion terraces along the valley walls of the Monongahela river and its large tributaries—Cheat, West Fork and Tygart Valley—in the three counties under discussion. The **first terrace** comes 30 to 40 feet above the river at Morgantown, at an elevation of about 830′ A. T.; the **second,** 75 to 80 feet above the river, at about 875′ A. T.; the **third,** 125 to 175 feet above the river, at about 920′ to 970′ A. T.; the **fourth,** about 200 feet above the river, at about 1000′ A. T.; and the **fifth,** 275 to 300 feet above the river, at about 1070′ to 1100′ A. T.

The latter represents the highest level reached by the ancient Lake Monongahela of glacial time, the lower terraces its successive stages, resulting from the spasmodic lowering of the outlet from the great ice and glacial drift dam impounding its waters.

I. C. White gives the following interesting paper, published on pages 368-379 of Vol. XVIII of "The American Geologist," dated August, 1896, on these high terraces and their deposits along the Monongahela:

Origin of the High Terrace Deposits of the Monongahela River.

"At the Minneapolis meeting of the A. A. A. S., in 1883, the writer presented a paper before Section E in explanation of the terrace deposits along the Monongahela river, as well as those along the old and abandoned Teazes valley, which extends from the Great Kanawha at St. Albans, along the C. & O. R. R. to the Ohio river at Guyandotte.

"In that paper the origin of these deposits was referred to the hypothetical glacial dam in the region of Cincinnati, evidence for the existence of which had just been published by Prof. G. F. Wright, of Oberlin, Ohio.

"Continued studies of the river between the Great Kanawha and the Monongahela have still led the writer to refer the terrace deposits of the latter river to a glacial dam, but not to the one which Prof. Wright believes existed at Cincinnati.

"It is now pretty surely established, through the work of Carll, Spencer, Hice, Foshay, Chamberlin, Leverett, and others, that the

Monongahela, lower Allegheny, and upper Ohio waters drained northward into the Lake Erie basin in pre-glacial time. The great ice-field which covered northern Ohio and Pennsylvania, and descended southward nearly to the Ohio river at Rochester, or Beaver, Pa., would, of course, effectually stop the northward drainage of this pre-glacial river, and impound the accumulating water into a vast lake-like reservoir, until it filled up to the level of any divides that might lead the surplus water across them to other drainage channels.

"If any such old outlets exist, they would furnish almost a demonstration of the reality of this supposed glacial lake, which I have named Lake Monongahela. The writer has often called the attention of geologists to a remarkable old gap in the divide which now separates the Ohio and Monongahela waters, at the head of the latter stream, just west of Salem on the Baltimore and Ohio Southwestern R. R., thirty-six miles west from Grafton. It is a valley 300 to 400 feet wide, filled with clay deposits, and separating Ten Mile creek, on the Monongahela side, from Middle Island creek waters of the Ohio drainage. The summit of this coll, one mile west of Salem, is 1,102 feet, A. T., while the bottom of the cut through it on the railroad or bed-rock under the clay-covered summit, is 1,081 feet, A. T.

"At the head of Rock Camp creek, another tributary of Ten Mile creek, which heads several miles (8 to 10 miles) north of Salem, there is another gap through the divide at exactly 1,143 feet, A. T., as determined by an experimental R. R. survey. Also, Prof. T. M. Jackson informs me that there is a third gap through the same divide, one mile north from the one on the Baltimore & Ohio R. R., and through this the North West turnpike passes.

"The general elevation of the divide which separates the waters of Ten Mile and Middle Island creeks is 1,400 feet to 1,500 feet, A. T. Here, then, are three gashes or wiers cut down 300 feet below the general level into valleys of considerable breadth from whose level summits the waters now go in opposite directions.

"The escape of the impounded water of Lake Monongahela would sufficiently account for these old channels or colls. Curiously enough, there is another outlet at this same level (1,100' A. T.) near the headwaters of the West Fork of the Monongahela, since the wide level summit at Arnold's, on the West Virginia and Pittsburgh R. R., is 1,095 feet A. T., and the railroad is cut five to six feet below the level stretch of land which makes the divide between the Monongahela and Little Kanawha waters. This 1,100 foot divide at three or four different outlets from Lake Monongahela, could hardly be a coincidence merely, but must represent the old colls through which the surplus water of the imprisoned rivers escaped to lower levels during glacial times.

"We thus have at hand an explanation of the immense deposits of stratified silts, clays, boulder beds, and other trash found at the junction of streams all along the Monongahela river, and especially above the level of the upper slopes of the river gorge, beginning at one hundred to one hundred and fifty feet above the present river.

"A large stream, Deckers creek, joins the Monongahela at Morgantown, coming in from the east after cutting through Chestnut ridge and draining a large mountain area east from the latter. At its junction with the Monongahela it has dumped large deposits of sand, boulders, and clay, which after much erosion still retain, in favorable localities a depth of seventy feet. From this fact, and also because these deposits were first studied there I have named them the Morgantown beds, confining the name to the deposits which rest on the pre-glacial

rock floor of the river. These beds, which are often as distinctly stratified as the underlying Coal Measure rocks, can be found wherever any shelf of the ancient rock-floor of the river has been preserved, from the head of the Monongahela to Pittsburgh, and on northwestward along the Ohio, and up the Beaver until they are met and submerged by the vast deposits of the terminal moraine. About one mile north from Morgantown, and near the Flats school-house, these beds contain beautifully preserved fossil plants imbedded in a bluish gray pottery clay of impalpable fineness. The plant bed lies at an elevation of 240 feet above the present river, or about 1,030 feet A. T.

"The small collection that I made of these plants and deposited in the West Virginia University, several years ago, together with collections made at different times by Prof. S. B. Brown, of the University, and also some collected by Mr. Walter Hough, of the National Museum, were all sent to Dr. F. H. Knowlton, the accomplished paleobotanist of the U. S. National Museum, Washington, D. C., for identification. Under date of Sept. 17th, 1895, Dr. Knowlton sent me the following account of these fossils:

Report on a Collection of Fossil Plants from Morgantown, West Virginia.

By F. H. Knowlton, Ph.D.

"'Some years ago I was informed by Dr. Walter Hough of the U. S. National Museum of the existence of finely preserved fossil leaves in the vicinity of Morgantown, W. Va. A few small fragments were brought to the Museum by Dr. Hough, but it was not until 1894 that a collection of any magnitude was obtained. These proved to be of so much interest that the collection in the West Virginia University has also, by the kindness of S. B. Brown, professor of geology, been placed at my disposal. This material has all been made use of in the following examination:

"'The study of these plants has not been quite completed, but enough has been done to transmit the following presentation. A few well preserved examples appear to be new to science or at least not readily identifiable with known forms.

"'Thus far ten forms have been determined with much certainty as follows:

1. **Esquisetum arvense** L.

A small fragment of a sterile branch.

This species is distributed from Virginia to California and northward to Greenland, and is also found in Europe. It is very abundant and attains perhaps its maximum development in New England.

2. **Cyperus sp.**

There are a number of stems that belong evidently to some cyperaceous plant, but they are too fragmentary to be determined.

3. **Potamogeton robbinsii** Oakes.

There are a great number of fragments of stems and leaves of this species, all so well preserved as to leave no doubt as to the correctness of their identification. Its present distribution is from New Brunswick to New Jersey, north of Lake Superior and northward.

4. **Liquidambar styracifolia** L.

A number of fruiting heads and leaves are referred to this species. Its present distribution is from Connecticut and Illinois to Florida and Texas.

5. **Platanus occidentalis** L. **Sycamore.**

Several fruiting heads are referred to this species. It is found from Maine to Vermont, south.

6. **Ulmus racemosa Thomas. The White Elm.**

A well preserved leaf is referred to this species. It is now found from Ontario and Vermont to Missouri and Kentucky. It is nowhere very common, but is most abundant at the north.

7. **Quercus falcata** Mich.

Two finely preserved leaves of this species. It is found from Long Island to Florida.

8. **Betula nigra** L. **Black Birch.**

There are several leaves of this species all perfectly preserved. The tree is now distributed from Massachusetts to Florida.

9. **Fagus ferruginea** Ait. **Beech.**

A large number of well preserved leaves are referred without hesitation to this species. It is a common tree from Nova Scotia to Florida and west.

10. **Castanea pumila** Mill. **Chinquapin.**

A single leaf only is referred to this form. It now grows commonly from Pennsylvania to Florida and west to Indiana and Texas.

The species thus far determined all belong to living species. Some of them enjoy a wide distribution and are still found growing in the region, while others are now only found to the north. One in particular **Potamogeton robbinsii**, is confined to the north.

It seems probable from the evidence of the plants that they were pushed down from the north during the ice invasion and were entombed, while the species has retreated again to the colder area.'"

"The occurrence of **Potamogeton robbinsii** in these beds is of special interest, since it practically demonstrates that there was during Glacial times a movement of water from the edge of the ice near Beaver, Pa., southward along the Monongahela valley through the escape wiers just described, which brought with it this northern plant. It is possible that a systematic search would bring to light many other such northern forms, as well as throw much light upon the slight changes that have taken place in species since the Glacial epoch, because there can be little doubt that these plants were embedded in their present matrix during the Ice age. The particular locality in which the plants occur is near the headwaters of two little streams which rise against each other, and then flowing north, empty into the Monongahela, their mouths being two and one-half miles apart.

"The broad level summit between the heads of the two streams is covered with the clay deposits up to 251 feet above the present river bed, and at one locality (Mr. Baker's well) they have a thickness of 65 feet. The surrounding hills are made up of the soft shales of the Barren or Elk River coal measures, and it is in just such a sheltered bayou back from the main channel of the river that we would expect to find such deposits in Lake Monongahela.

"A fine quality of clay for common blue stoneware, or crockery is always found among these deposits where any considerable stream empties into the Monongahela from the west (soft rock areas), while sand and boulders predominate at the mouths of those streams draining from the east (mountain or sand-rock areas). The celebrated pottery clays of Geneva and Greensboro, Pa., just north from the West Virginia-Pennsylvania line are deposited opposite the mouth of Dunkard creek, a stream entering the Monongahela from the west, and draining quite a large area of Permian shales. Here the following structure is exposed at the clay diggings back of Geneva in descending to the Monongahela river:

		Feet.
1.	Rounded boulders, sand, and river trash	50
2.	Soil, boulders, etc., to top of clay bed	5
3.	Reddish clay, fine, tough	10
4.	Clay mixed with sand, and brown iron ore	6
5.	Bluish gray clay, fine, tough	10
6.	Bed-rock to level of Monongahela river	140

"The elevation of low water here is 772′ A. T. so that the rock floor of the old river is now 912′ A. T.

"The same kind of clay as that at Greensboro and Geneva, and which occurs at 150 feet above the river on the Millan farm, West Morgantown, was analyzed by Dr. De Roode, chemist of the U. S. Agricultural Experiment Station at Morgantown, W. Va., with the following results:

	Per cent.
Silica	65.95
Alumina	20.23
Oxides of iron	3.17
Lime	0.32
Magnesia	1.36
Soda	0.53
Potash	2.60
Water and loss	5.84
Total	100.00

"At Morgantown, sixteen miles above Geneva, the level of the old rock floor at the head of High street is 916 feet A. T. or 129 feet above river level, and the same at the University buildings, which are situated on top of this old river channel. But on the west side of the river, at Keck's hill, where the deposit is 70 feet thick, the level of the old floor is only 905 feet A. T. This difference between Morgantown and Geneva is to be explained because of the soft shale floor of the old channel at Morgantown, which was eroded deeper than the hard sandstone of the old channel at Geneva.

"At Uffington, three and one-half miles above Morgantown, near the mouth of Booth's creek, we find the level of the old floor on the hard Mahoning sandstone under a large deposit of sand (brought out of the mountains from the east by Booth's creek), at 915 feet A. T., or 125 feet above the present bed.

"Fairmont and Palestine at the junction of the Tygart's Valley and West Fork rivers, 26 miles above Morgantown, are situated on the wide plain excavated by the pre-glacial river, and as might be expected, the old rock floor is covered to a great depth with terrace deposits, consisting of sand, rounded boulders, etc., from Tygart's valley, and pottery clays from the West Fork river. The elevation of the old rock-floor is 972.5 feet A. T., or 122 feet above the present river, while the top of these deposits extends up to 1,067 feet A. T.

"The terrace material at Fairmont has been well exposed along Fairmont avenue, and its stratified condition is well shown. At the Smith & McKinney building the excavation showed the different stratified layers of sand and clay dipping about 10° to the west.

"A layer of clay about eight feet thick, at near 1,000 feet A. T., has long been mined for pottery clay in the Fairmont region. The corresponding bed at Morgantown has an elevation of 945 feet A. T.

"At Clarksburg, thirty miles above Fairmont, the West Fork river is joined by a large tributary, Elk creek, and the two streams

had carved out a wide valley in pre-glacial time, whose rock-floor under the city has an elevation of 986 feet A. T., or about 70 feet above low water (916 feet A. T.) at the junction of Elk and the West Fork rivers. Here a great deposit of clays and quick-sand, twenty-five feet thick, covers all the level surfaces up to 1,020 feet, A. T. There are some layers of rather coarse sand in the deposits, but the clays predominate, and they are found all along the West Fork river, and its tributaries from Fairmont to Clarksburg and on beyond to Weston, thirty miles south, where they extend to only about thirty feet (1,020 feet A. T.) above water level (990 feet, A. T.).

"At Grafton, on the Tygart's Valley river, twenty-two miles above Fairmont, the elevation of the top of the railroad pier in the river is 997 feet and the terrace deposits extend only about twenty-five higher.

"The principal town sites along the Monongahela river from Weston to Pittsburgh viz: Weston, Clarksburg, Grafton, Monongah, Fairmont, Palatine, Montana, Morgantown, Point Marion, Geneva, Greensboro, Rice's Landing, Fredericktown, Brownsville, Belle Vernon, Charleroi, Monongahela, Elizabeth, McKeesport, Braddock, Homestead, all have their upper and more level portions situated on the ancient floor of the pre-glacial valley. It is this wide and almost level area of deposits stretching from Braddock to the Monongahela, across to the Allegheny river via Homestead, and East Liberty, which forms the principal site of Pittsburgh itself, as well as Allegheny, beyond. Here a remnant of this ancient valley floor is appropriately named Monument hill, rising, as it does, like an island between the present mouth of the Allegheny river and its filled-up and more ancient channel just north of the island. The bed rock under the terrace deposits of Monument hill is now 190 feet above low water, or 890 feet above tide, and the rock floor under the vast terrace deposits at Bellevue, still further down the Ohio river comes at the same elevation, while the summit of the same deposit there as well as in Pittsburgh and Allegheny, has nowhere been observed above 900 feet A. T., or 290 feet above low water in the present rivers.

"This old elevated valley floor can be followed down the Ohio river to Rochester, and up the Beaver river past New Brighton, Beaver Falls, Rock Point, Wampum, Mahoningtown and New Castle, beyond which, up the Shenango, it sinks out of sight under the drift-filled valleys, and at Sharon is submerged by 60 feet of cover, 40 feet below the present water level or 780 feet A. T.

"The exact course of the pre-glacial river from Sharon northwestward to the Lake Erie basin has not yet been clearly delineated, but Mr. Leverett's studies leave little doubt that from Sharon, the course was northwestward through the low drift-filled divide at Warren, O., (now only 900 feet A. T., and its rock floor probably 200 feet lower), and thence northward along the general course of Grand river.

"Just how long Lake Monongahela existed, and drained its surplus waters southward through the Middle Island and Little Kanawha gateways, cannot be estimated except by the deposits just described; but finally the barrier along the upper Ohio, (probably at the 'Narrows' below Moundsville, W. Va., as believed by Profs. Chamberlin and Leverett) gave way, and the level of Lake Monongahela was speedily lowered by the rapid cutting away of the soft rocks along the present Ohio valley. Just how much of Ohio river history dates from this interglacial origin, it is yet impossible to determine, but the character of the topography along the river, everywhere between

Rochester, Pa., and Cincinnati, O., (below which the writer has not studied it), would lead to the conclusion that all this portion of the river is new, and that the conclusions of Prof. Tight, of Denison University, Granville, O., are well maintained, viz.; that in pre-glacial times the waters of the Muskingum, Scioto, and other rivers of Ohio, all flowed northward into the Lake Erie system.

"This being true, it would follow as a corollary that all of the West Virginia rivers which rise on the western slope of the Allegheny mountain-divide including the Little and Big Kanawhas and the Big Sandy, must have once gone northward in pre-glacial times and joined the Scioto, Muskingum, and other Ohio streams in their northward course, right athwart the present valley of the Ohio, but on a plane probably 200 to 300 feet above the present rock floor of the Ohio. The search for these former high level valleys north from the Ohio, as bisected by it, is reserved for a future chapter, and it is possible that therein may be found an explanation of the old and abandoned high level Teazes valley, which does not admit of the explanation suggested by Prof. William M. Davis, in a recent number of 'Science,' viz.; stream piracy of Coal river by the Great Kanawha, because the old valley in question is filled with transported boulders and gravel that could have come only from the crystalline rocks of the Blue Ridge in Virginia, and hence the Kanawha itself must once have flowed along the Teazes valley, and been captured by another stream which led it northward to the newly cut Ohio valley, at Point Pleasant.

"If the conclusions here inferred could be fully sustained by further study of the Ohio river system, it will be readily perceived that a pre-glacial drainage map of Pennsylvania, Ohio, West Virginia, and Kentucky would bear very little resemblance to a map of the present drainage, for if the Monongahela, Lower and Upper Allegheny once went northward into the Lake Erie basin, there can be no doubt that the Upper Susquehanna also took this northward route to the sea, in pre-glacial times, and that much of its present course through Pennsylvania is new. The resultant modifications which such a change of direction in a great river system must necessarily bring to pre-existing drainage lines, are so varied and amazing even in contemplation, that their study must furnish many problems of surpassing interest to topographers of the modern school, so ably typified by Prof. Davis and his work.

"The following table represents the descent of the ancient Monongahela river toward the lake region for a portion of its course between Weston, W. Va., and Sharon, Pa., as well as the present water levels between the same points, and also the highest levels of the Morgantown beds, where known:

Miles		Present river, A. T.	Ancient river, A. T.	Top of Deposits A. T.
0	Weston	990	1,000	1,030
40	Clarksburg	916	986	1,020
75	Fairmont	851	973	1,067
101	Morgantown	787	916	1,038
117	Geneva	772	912	1,022
206	Pittsburgh	700	890	990
332	Rochester	662	865	.....
237	Beaver Falls	715	860	.....
246	Rock Point	740	840	.....
257	New Castle	780	825	.....
278	Sharon	840	780	.....

"This table shows that while the present river falls 290 feet between Weston and Pittsburgh, the floor of the ancient stream descended only 110 between the same points, or only about one-half foot per mile, which is practically that of a base-leveled valley, or one quite advanced in age, to say the least. The rapid descent of the modern river below the old rock floor of the ancient one gives rise to the steep slopes and gorge-like character of the Monongahela valley everywhere between Weston and Pittsburgh, while the same is true of the lower courses of all the larger tributary streams, the descent in these being very rapid in the last few miles of their courses, while in their upper reaches the slope is gentle and the topography much older looking.

"The smaller streams, which rise only five to ten miles back from the Monongahela, descend to it in the last mile or two of their courses by a series of rapids and cascades, while the still smaller brooks and rivulets have cut mere notches in the bounding valley walls below the level of the ancient rock floor of the Monongahela, so that every feature of the topography tends to confirm the conclusion that the age of the river below the old base-leveled plain shown in the table, has been of comparative short duration, and must be measured by only a few thousand years at most.

"The writer had intended to present a map with this paper, showing in a crude way the pre-glacial drainage of the areas herein described, but so much detailed work must yet be done before any approach to accuracy can be hoped for that the mapping is left for other and more skillful workers in this promising field. In this connection I would call the attention of students of the subject to the former northward course of the Little Beaver and the Slippery Rock.

"The former once went northward along with the Monongahela drainage, but being dammed up by the northern ice it cut a new channel about fifteen miles long, southward into the Ohio river drainage, and this fully accounts for the wonderful change in topography along the lower portion of its course, as well as for the southward transportation of large granite boulders several miles beyond the limits of true glacial movement, thus giving rise to the phenomena called the 'fringe' by Lewis and Wright; for wherever a stream was thus impounded the blocks of ice floating southward across these temporary lakes from the terminus of the glacier would of course bear away and, melting, scatter over the surface many masses of imbedded rock.

"The Slippery Rock now joins the Connoquenessing in a curious manner, by meeting it direct, and the combined stream turns off at right angles to enter the Beaver at Rock Point. In pre-glacial time the Slippery Rock left its present channel a short distance above Kennedy's upper mill, and following the present valley of Big run, turned northwestward near New Castle, and cutting squarely across the present gorge of the Neshannock (which is also of post-glacial origin) passed two and one-half miles north of New Castle and entered the ancient Monongahela near Harbor Bridge. All this is fully attested by the wide drift buried valley, which can be followed from Slippery Rock clear through to the Shenango, and the courses of this ancient stream also confirms the conclusion of Leverett that the pre-glacial drainage took the Shenango route via Sharon instead of the Mahoning, and that the lower portion of the latter stream is of recent origin. The Slippery Rock was turned southward at Kennedy's upper mill by the advancing ice-sheet which filled its pre-glacial valley, and on retreating left a dam of drift 100 feet high

across its former course, while the wild gorge and raging stream between Kennedy's mill and the Connoquenessing, so different from the wide valley and sluggish current above the mill, though the outcropping rocks are the same, fully attest the recent origin of the twenty-mile cut between the mill and the Connoquenessing, near Wirtemburg."

PART III.

The Geology of the Monongalia-Marion-Taylor Area

CHAPTER III.

STRUCTURE.

Introduction.

Geologic structure treats of the pitch or lay of the stratified rocks. The first position of rock beds whether formed from lava flows or by sedimentation is regularly horizontal. Their original position, however, is later much changed by tangential pressure effected by the contraction of the earth's interior, and the strata composing the crust of the latter are thus bent and warped by this pressure into a number of parallel wrinkles or folds In the area under discussion these folds all have a northeast-southwest trend. In the discussion of these structural forms on subsequent pages, the upward bending arch is known as an **anticline**; the downward bending trough, a **syncline**; the line joining the highest points of an anticline or the lowest points of a syncline, the **axis** of the fold; the direction of the horizontal edges of dipping strata, the **strike**; and the structural form resulting from the sudden rise or fall of the axis of an anticline the **nose** of the fold.

Method of Representing Structure.

There are two methods of representing structure in geologic mapping in general use, both of which have been dis-

cussed in detail by the writer in former county reports of the State Survey. The contour line method has been selected for this report, since no faults occur and the folds with one exception are comparatively low. The Pittsburgh coal bed has been selected as the 'key rock' on which to base the structure, since it is very persistent and widely known in the area both from exploitation by miners, and by drillers for oil and gas. It also crops over a large portion of the three counties.

The elevation of the top of the Pittsburgh coal over a large part of the area was obtained by levels directly on its crop, but in western Monongalia and Marion counties, the horizon of this coal lies deeply buried below drainage, so that its elevation therein had to be determined largely from the logs of oil and gas well borings, diamond drill holes and coal mine shafts that had penetrated the seam, or from its interval below some definitely recognized stratum cropping above, the two most important of which are the Washington and Waynesburg coals. The following table gives accurate measurements for the two latter seams down to the top of the Pittsburgh bed at several points, arranged in alphabetical order in Monongalia and Marion counties. The numbers in parentheses refer to map and tabulated numbers of wells mentioned in text:

Table Showing Intervals to Top of the Pittsburgh Coal.

	Waynesburg Coal. Feet.	Washington Coal. Feet.
Annabelle (634A), 1.2 miles north of	405	...
Annabelle (635), 1 mile northeast	...	560
Behler (230), 2.3 miles south 80° E	367	...
Bingamon (535), 2 miles N 80° W	385	...
Blacksville (148), 1.3 mile SW of	356	...
Bowlby (250), 1 mile NE of	368	...
Bowlby (252), 1.3 miles NW of	375	...
Cassville (265), 1 mile NE of	366	...
Cassville, (268), 1 mile NW of	375	...
Cassville (291), 1.5 miles SE of	393	...
Dolls run (297), head of	361	...
Fairview (555), 1 mile NE of	383	558
Fairview (556), 0.8 mile N of	375	...
Georgetown (310), 1.3 miles NW of	382	...
Glover Gap (348), 2 miles NW of	...	509
Grays Flat (664), 1.2 miles S of	403	...
Hagans (232), 0.5 mile east of	376	...

	Waynesburg Coal. Feet.	Washington Coal. Feet.
Mannington (497), 0.5 mile N of	381	...
Mannington (516), 2.5 miles SW of	...	551
Mannington (541), 0.5 mile S of	384	...
Maple (10), 0.5 mile NE of	335	...
Maple (12), 1 mile N of	325	...
McClellan (591), 1.5 miles N 10° E of	393	...
McClellan (596), 1 mile SW of	...	550
McClellan (599), 1.2 miles SW of	400	550
McClellan (612), 1.5 miles SE of	400	...
Monongah (658), 2 miles N 10° W of	415	...
Mooresville (168), 0.4 mile E of	372	...
Pleasantville (536), 0.7 mile NE	375	...
Ragtown (117), 1.3 miles SW of	360	...
Rymer (371), 1.7 miles W of	311	...
Underwood (622), 0.6 mile SW of	410	...
Wadestown (53), 1.5 miles SW of	397	522
Wadestown (80), 1.3 miles SE of	372	...
Worley (171), 0.5 miles SW of	...	532
Worley (172), 0.6 miles NE of	340	...

The contour lines show the elevation of the top instead of the base of the Pittsburgh coal, since a large number of the logs obtained from wells in the above mentioned region record only the depth to the top of the coal and omit the thickness. In the eastern portions of the three counties this coal passes into the air above the summits of the highest hills, and there the elevation of its horizon was largely determined from the assumption of the following intervals to well known formations of the Conemaugh, Allegheny and Pottsville series of the Upper Carboniferous:

Table Showing Intervals to Top of Pittsburgh Coal.

Formation.	Feet.
Clarksburg coal	140
Elk Lick coal	250
Harlem coal	330
Bakerstown coal	420
Brush Creek coal	540
Upper Freeport coal	610
Lower Freeport coal	660
Upper Kittanning coal	720
Lower Kittanning coal	780
Clarion coal	830
Homewood sandstone, top of	840
Homewood sandstone, base of	880
Tionesta coal	880
Upper Mercer coal	910
Upper Connoquenessing sandstone, top of	930
Upper Connoquenessing sandstone, base of	1000
Quakertown coal	1000

On Map II the structure contour lines are printed in green, and these exhibit not only the approximate elevation above sea level of the top of the Pittsburgh coal, but the horizontal contours of the troughs, arches and domes, and the direction of the dip of the strata. A glance at this map will readily show whether or not the coal is above or below drainage at any point in the three counties by noting the elevation of the land surface at the point desired as exhibited by the topographic contours, and the elevation of the coal as shown by the structure contours at the same place. For instance, suppose the position of the Pittsburgh coal was desired at Mannington. The map shows the elevation of Buffalo creek there to be about 960′ A. T., and the elevation of the coal as exhibited by the contour lines, about 550′ A. T.; hence, the bed should lie about 410 feet below drainage.

As mentioned in preceding county reports, these structure contours are only approximately correct from the assumed fact that over small areas the rocks maintain a uniform thickness, although it has often been established that the interval beween two easily determined formations will vary many feet in a short distance. While a large number of elevations were determined with spirit level, much the greater number was obtained with the aneroid barometer checked as frequently as possible on spirit level elevations of the U. S. G. Survey, marked at forks of public highways and other conspicuous places. These checks kept down errors in barometric elevations to the extent that it is believed that over most of the area their sum is less than one contour interval—that is, less than 25 feet, except on the steep slope of the Chestnut Ridge anticline north of the 39° 30′ parallel of N Latitude, where the contour interval is 100 feet.

Detailed Geologic Structure.

The Monongalia-Marion-Taylor area lies along the eastern flank of the great Appalachian Basin or geo-syncline, concerning which a brief account is given by I. C. White on pages 84-85 of Vol. II of the State Geological Reports. Although the three counties lie near the axis and on the eastern

structural slope of this great basin, yet their area is traversed in a northeast-southwest direction by a number of minor folds, the most important of which are as follows:

Anticlines.	Synclines.
Amity.	Robinson.
Bellevernon (Waynesburg).	Waynesburg.
Wolf Summit.	Whiteley.
Mooresville (Brownsville).	Shinnston.
Indiana (Fayette).	Lambert.
Chestnut Ridge (Dulany).	Connellsville (Uniontown).
Hiram.	Ligonier (Elliottsville).
	Evansville.

The accurate location and shape of the above folds are exhibited on Map II. A brief description will now be given of these anticlines and synclines in the order listed above.

Amity Anticline.—This fold lies between the Robinson and Waynesburg synclines and is no doubt an extension of the Amity anticline of Stone and Clapp[1], or the Pinhook arch of Stevenson and White. As outlined on Map II, the axis of the anticline enters Monongalia from Greene county, Pa., about one mile west from Jollytown, and bears south 25° to 30° west to its termination near the Monongalia-Wetzel county boundary.

The elevation of the Pittsburgh coal along the crest of the fold varies slightly over 300 feet at the Pennsylvania-West Va. State line to about 175 feet one mile northward from the common corner to Monongalia, Marion and Wetzel counties.

Bellevernon Anticline.—The Bellevernon anticline of Stone and Clapp[2], or the Waynesburg of Stevenson[3], enters Monongalia at Blacksville, and dies out within two miles to the southward. Where the axis of the fold intersects the State line, the Pittsburgh coal has an elevation of almost 400 feet above sea level, but at its southern terminus the coal has dipped down to about 350′ A. T.; hence, only the nose of the fold enters the area under discussion.

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1. Bull. 304, Oil & Gas Fields of Greene County, Penna., U. S. Geol. Survey, p. 26; 1907.
2. Bull. 304, Oil & Gas, Greene County, Pa., U. S. G. Survey, p. 24; 1907.
3. J. J. Stevenson, Report K, Second Geol. Survey of Penna.; 1876

Wolf Summit Anticline.—This fold is one of the most prominent arches of Harrison county, a full description of which is given by the writer on pages 56-58 of the Doddridge-Harrison county report of the State Survey. As outlined on Map II, the axis of this fold enters Marion county from Harrison, one mile southwest of Sturms Mill, bears N. 30° to 35° E., intersecting Tevebaugh creek at Annabelle, and finally dies out west of Farmington (Underwood Sta.) It was thought formerly that this arch extended unbroken to the southern edge of Monongalia, one mile and a half west of McCurdyville, but a glance at Map II will show that the anticline at the latter place is separated from the Wolf Summit arch by the Shinnston syncline, and that the former anticline represents a separate and distinct fold, crossing Buffalo creek one mile and a half east of Farmington.

Where the axis of the Wolf Summit arch crosses the Harrison-Marion line, the Pittsburgh coal has an elevation of about 925′ A. T., but the coal dips rapidly northeastward along the nose of the fold, and at Buffalo creek, one mile west of Farmington, has an elevation of slightly less than 700′ A. T.

Mooresville (Brownsville) Anticline.—The axis of this arch as outlined on Map II, enters Monongalia from Greene county, Pa., a mile and a third northeast of Pentress, bears southwestward, passing one-fourth mile west of Mooresville and 0.8 mile east of Statler Run, intersecting the Monongalia-Marion line, one mile and a half west of McCurdyville. From the latter place it continues its southwest course, crosses Pawpaw creek one mile and a half southeast of Fairview, and at a point one mile northward from Upton suddenly veers to a southeast course for a distance of two miles to again resume its original course, crossing Buffalo creek one mile and a half east of Farmington. From the latter point the axis bears almost due southward, and crosses West Fork river at the east edge of Everson and the Marion-Harrison line a mile and a half westward from Eldora, where it finally dies out on the eastern slope of the Chestnut Ridge anticline, forming the structural terrace upon which occurs the famous "Shinnston Oil Field" of northeastern Harrison county in the vicinity of

Adamsville. The writer has designated it the Mooresville anticline from the town of that name near its crest in northern Monongalia. It appears quite probable that this fold is an extension of the Brownsville anticline of M. R. Campbell[4], or a minor wrinkle in the large synclinal basin lying between the Bellevernon and Fayette (Indiana) anticlines. The latter party, however, did not outline the axis southwestward beyond Willow Tree. From the latter region it probably veers to the westward as does the axis of the Lambert syncline, to near the head of North branch of Calvin run, and thence to the State line at the point designated above for theMooresville arch.

Along the axis of this anticline the Pittsburgh coal rises rapidly southward forming a marked nose in the fold, from about 430′ A. T. to about 525′ A. T. near the head of Long Drain, a mile and a half south of Mooresville, where it flattens somewhat southwestward to the Monongalia-Marion line, the coal having there an elevation of about 740′ A. T. It again resumes its rapid southwest rise to a dome-like structure, 2 miles south 30° E. of Fairview where the coal attains an elevation of 750′ A. T. From the latter place it dips slightly southward to 720′ A. T. at Buffalo creek, and again forms another nose in the fold by rising rapidly southward to an elevation of 900′ A. T. at the West Fork river, and 1050′ A. T. at the Marion-Harrison line.

Indiana (Fayette) Anticline.—The Indiana (Fayette) anticline of Stevenson enters Monongalia from the southwestern point of Fayette county, Pa., bears south 20° to 25° west, and crosses West run 2 miles northwest of Easton and the Monongahela river 0.8 mile north of the mouth of Deckers creek at Morgantown. From the latter point it keeps the same course, following closely the west side of the Monongahela river to near Scrafford, crossing the latter stream 0.5 mile west of Uffington and again at Little Falls to disappear finally a short distance southwest of the latter point on the steep western slope of the Chestnut Ridge anticline. Where the axis of this fold intersects the State line on the east hill side of

4. Masontown-Uniontown Folio No. 82, U. S. G. Survey; 1902.

the Monongahela river, the Pittsburgh coal has an elevation of 1160′ A. T. Southwestward its horizon rises rapidly along the axis, forming a nose to the fold and elevating the same to 1300′ A. T. west of Morgantown, 1400′ A. T. west of Scrafford, 1450′ A. T., 0.5 mile west of Uffington, and about 1480′ A. T. at Little Falls.

Chestnut Ridge Anticline.—This great arch is by far the most pronounced structural feature in the area under discussion and has been so designated by J. J. Stevenson from a ridge of that name in eastern Monongalia. It has also been called the Laurel Hill Anticline by Rogers[5] and the Dulany anticline by Campbell[6], and is probably the longest continuous structural fold in the State. Its course southwestward in the latter area has already been outlined by the writer on pages 58 and 59 of the Doddridge-Harrison Report of the State Survey. The axis of the fold enters West Virginia about one mile east of the northeastern corner of Monongalia, bears south 20° to 30° west and intersects the Preston-Monongalia line one mile and six-tenths northwest of Pisgah; Cheat river, one mile and four-tenths northwest of Beaverhole; Deckers creek, 1 mile southeast of Sturgisson; and the Monongalia-Marion county line, 0.4 mile northwest of the common corner to Monongalia, Taylor and Marion counties. From the latter place it veers to an almost west course to a point about two miles east of Hammond, where it resumes its original southwest course, crossing Tygart Valley river 0.6 mile northwest of Valley Falls, Husted creek, a mile and a half north of Meadland, and the Taylor-Harrison county line just north of the Northwestern turnpike. The shape of this fold is exhibited in a graphic manner by the green contour lines on Map II. North of the 39° 30′ parallel of North latitude the dip on both flanks of the arch is so rapid that for the sake of clearness only the even hundred-foot contour intervals were given three to four miles down on each side of the crest. Owing to the fact that intervals had to be relied on entirely to get the elevation of the horizon of the Pittsburgh coal in this mountain-

5. Rogers, W. B., Geology of the Virginias, p. 369; 1884.
6. Campbell, M. R., Masontown-Uniontown Folio No. 82, U. S. G. Survey; 1902.

ous region of rapidly dipping strata, the contours are only approximate. In any case, however, the possible error is likely less than one contour interval—that is, less than 100 feet.

A glance at Map II shows that the axis dips rapidly southwestward to near Cheat river where it apparently flattens for two to three miles, to rise again in the dome-like structure at Decker's creek. From the latter place it dips rapidly along the nose of the fold to a point 3 miles northeast of Valley Falls, where it flattens locally for a distance of two miles. Where the fold enters Monongalia county the Pittsburgh coal horizon has an elevation of about 3500′ A. T., and where the arch leaves the area discussed, at the Taylor-Harrison line, the same horizon is only about 1460′ A. T., giving a total fall of 2040 feet in the axis of the anticline within the three counties.

Hiram Anticline.—The shape and location of this fold are well exhibited on Map II in the southeastern corner of Taylor county. The arch apparently has its northeastern terminus two miles southwest of Newburg, Preston county, from which place its axis bears south 15° to 20° west, and intersects the Preston-Taylor line 2.2 miles due north of Eby, and the Taylor-Barbour line 0.5 mile southeast of Hiram postoffice, from which place it has been named by the writer. It is apparently a minor wrinkle or fold in the great Ligonier Basin, separating the latter into two distinct limbs southwestward from Newburg, one of which bears southwestward via Grafton, Taylor county, and the other southward via Evansville, Preston county.

As represented in Taylor county, the Hiram anticline is probably only the nose of a greater fold to the southwest in Barbour. At its northeastern terminus the Pittsburgh coal has an elevation of about 1750′ A. T., but its horizon rises rapidly southwestward along the axis to slightly over 2000′ A. T. at the latter's intersection with Sandy creek. Just where this fold crosses the Tygart Valley river has not yet been accurately determined.

Robinson Syncline.—The Robinson syncline is the deep structural basin lying between the Amity and Wolf Summit

anticlines on the east and the Hundred and Arches Fork anticlines on the west. It was so named by the writer on page 69 of the Marshall-Wetzel-Tyler Report of the State Survey from a town of the same name in southeastern Wetzel county near which it passes. The writer has given a full description of its course across the State on pages 62-63 of the Doddridge-Harrison Report. A glance at Map II shows that the Pittsburgh coal attains a lower elevation—less than 100′ A. T.—in this Basin in the southwestern point of Marion county, than at any other portion of the three counties.

As outlined on Map II, the axis of the syncline enters Monongalia from Greene county, Penna., in the extreme northwestern point of Battelle district, bears southeast for 2 miles to near St. Cloud, and then veers to a southwest course, following roughly the Monongalia-Wetzel county line, and crossing the Wetzel-Marion line one-fourth mile east of the Glover Gap railway tunnel; Bartholomew fork a mile and a fifth northwest of Seven Pines; and the Marion-Wetzel line again, on the head of Owen Davy creek, 2 miles southwest of Curtisville. The log of the J. L. Hamilton No. 1 well (360) shows a marked canoe-shaped depression along the axis of the syncline where it crosses Bartholomew.

Waynesburg Syncline.—The axis of the Waynesburg syncline of J. J. Stevenson[7] enters Monongalia from Greene county, Pa., a mile and a half northwest of Wise (Wana P. O.), and bears southwestward to a point one mile eastward from Saint Leo, passing just to the east of Wadestown. It then veers to the west and dies out in the Robinson Basin, one mile northwest of the common corner to Monongalia, Marion and Wetzel counties. Its course through Greene county, Pa., is well exhibited by Stone & Clapp on their Plate I accompanying Bull. 304 of the U. S. Geol. Survey.

Where the axis intersects the State line, the Pittsburgh coal has an elevation of about 270′ A. T., but the latter bed dips rapidly southwestward along the axis to a point two miles southward from Wadestown, where it suddenly flattens down to the westward to its terminus in the Robinson trough,

7. Report K, Second Geol. Survey of Pa.; 1876.

the Basin itself widening out to a width of two to three miles.

The sudden convergence of the axes of the Waynesburg and Robinson synclines is due to two causes, viz.: the dying out of the Amity anticline, and the presence one mile southwest of Glover Gap of an anticlinal spur having a northwest-southeast direction, and a length of two to three miles.

Whiteley Syncline.—The Whiteley syncline of Stone & Clapp[8] lies between the Bellevernon and Fayette anticlines, but in the area under discussion, the writer shows its position to be between the Bellevernon and Mooresville arches. The axis of the trough enters Monongalia from Greene county, Pa., one mile northwest of Pentress, and bears southwestward 5 miles to the vicinity of Daybrook where it disappears on the western slope of the Mooresville anticline. The trough is quite shallow, especially in the last three miles of its course. Along its axis the Pittsburgh coal has an elevation of about 350′ A. T.

The fold is of minor importance in West Virginia, but northeastward it is a prominent structural feature of Greene county, Pa.

Shinnston Syncline.—The Shinnston syncline was so designated by the writer[9] from a town of the same name in Harrison county through which it passes. It is a very pronounced trough in the latter area where it lies between the Wolf Summit and Chestnut Ridge anticlines, but in Marion and Monongalia its eastern slopes rise to the crest of the Mooresville arch as shown on Map II. The axis of the basin enters Marion from Harrison county one mile west of the mouth of Bingamon creek, and bears northeastward to an intersection with Buffalo creek at the west edge of Farmington (Underwood Sta.), where it suddenly swerves to the northwest and dies out within two miles around the nose of the Wolf Summit arch.

Along the axis of this Basin at Bingamon creek the Pittsburgh coal has an elevation of about 850′ A. T., but northeastward the latter bed dips rapidly to about 700′ A. T., 0.5

8. Bull. 304, Oil and Gas, Greene Co., Pa., U. S. G. Survey, p. 24; 1907.

9. Doddridge-Harrison Rept., W. Va., Geol. Survey, pp. 63-65; 1912.

mile northeast of Festus. From the latter point the axis is almost horizontal northward to the Farmington region.

In the description of this trough on page 64 of the Doddridge-Harrison report, the writer erred as to its course northeastward from Festus, owing to the fact that the structure contours for Marion county had not at that time been worked out. A glance at Map II will show that on Buffalo creek the Shinnston and Lambert synclines are separated by the low Mooresville arch.

Lambert Syncline.—What appears to be an extension to the southwest of the Lambert syncline of M. R Campbell[9] enters Monongalia from Greene county, Pa., 2 miles north about 60° east of Worley. An examination of the structure contour map of Greene county, Pa., by Stone & Clapp of the U. S. G. Survey will show the possibility of the axis of the Lambert Basin's extending southward from Willow Tree to the headwaters of Meadow run, and thence southward to the State line to a connection with the same as outlined by the writer on Map II. In Monongalia it is undoubtedly the first structural basin to the west of the Indiana (Fayette) arch.

On entering the latter county, the axis bears southward to near the head of Pedlar run, where it veers more to the west and intersects the Monongalia-Marion county line just east of McCurdyville. It continues the same course for about 3 miles and then veers to the southeast, intersecting Pawpaw creek near the Federal shaft coal mine of the New England Gas & Coke Co., and Buffalo creek at the No. 7 Shaft mine of the Jamison Coal & Coke Co. Southwestward from the latter point it soon dies out in the vicinity of West Fork river on the western slope of the Chestnut Ridge anticline.

At the intersection of the axis of the trough with the State line, the elevation of the Pittsburgh coal is about 425′ A. T. The latter seam rises rapidly along the axis southward from the latter place to the vicinity of Behler, and then flattens down along a structural terrace to the vicinity of McCurdyville where it again rises fairly rapid for a mile and a half, to flatten down to a very shallow basin in the Barrackville re-

9. Masontown-Uniontown Folio No. 82, U. S. G. Survey; 1902.

gion. A well defined structural terrace intersects this Basin in the Stafford-Hoodsville region, extending northeastward entirely across Monongalia, via Georgetown, Cassville and Bowlby, as can readily be observed on Map II.

Connellsville (Uniontown) Syncline.—The structural basin along the western foot of the Chestnut-Laurel ridge was first named the **Connellsville**, but later M. R. Campbell[10] applied the name **Latrobe** to that portion of the trough northeastward from Connellsville, and **Uniontown**, to that portion southwestward from the same place, for the reason that the main Basin is divided into two distinct synclines near Connellsville, abutting against each other with a slight offset. The axis of the latter fold enters Monongalia about one mile southwest of Cheat Haven, bears southwestward via Stewartstown and Easton, and intersects Deckers creek at the Morgantown & Kingwood railroad shops, one mile southeast of Morgantown. From the latter point it continues the same course to Booths creek waters, a mile and a half southeast of Uffington, where it finally dies out, owing to the convergence of the axes of the Indiana and Chestnut Ridge anticlines.

At the lowest point of the Basin on the State line, the Pittsburgh coal has an elevation of 1065′ A. T. Southwestward along the axis of the trough the horizon of this bed rises gradually to 1150′ A. T. at Easton, and 1200′ A. T. near Deckers creek, where the rise increases rapidly, throwing the coal horizon up to about 1340′ A. T. at the Morgan-Clinton district line.

Although the Shinnston Basin lies immediately west of the Chestnut Ridge arch in Harrison county, yet a glance at Map II will readily show that this trough represents a separate and distinct basin.

Ligonier (Elliottsville) Syncline.—This structural fold lies immediately east of the Chestnut Ridge anticline, and has long been known as the Ligonier Basin. M. R. Campbell of the U. S. G. Survey, in the Masontown-Uniontown Folio No. 82, applied the name Elliottsville to a minor wrinkle in this great general syncline, from a town of that name in southern

10. Masontown-Uniontown Folio, No. 82, U. S. G. Survey; 1902.

Fayette county, Pa., near which it passes. The axis of this fold crosses the State line into Preston county, W. Va., about three miles northwest of Clifton Mills, bears southwestward, crossing Cheat river about one-half mile below the mouth of Big Sandy creek, passing one mile to the east of Masontown, one-half mile west of Reedsville, and thence to Newburg, where it splits into two separate limbs, one of which veers westward, and crosses the Preston-Taylor county line one mile south of Hardman. From the latter place the axis continues the same general course to Grafton where it changes to a more southerly course, passing one-half mile southeast of Pruntytown, through Wendel and Flemington, and intersecting the Taylor-Barbour county line about two miles east of the common corner of Taylor, Barbour and Harrison.

Where the axis intersects the Taylor-Preston line, the Pittsburgh coal has an elevation of about 1750′ A. T. Southwestward along the axis the same coal horizon dips gradually to 1575′ A. T. at Grafton. Here the dip increases rapidly and brings the coal down to 1335′ A. T. in the Pruntytown region, and 1225′ A. T. at Wendel. From the latter point the axis flattens down and brings the same coal down to slightly less than 1200′ A. T., 0.5 mile southeast of Flemington, the lowest portion of the Basin in Taylor county. From this locality the coal begins to rise gradually southward and at the Taylor-Barbour line has an elevation of about 1225′ A. T.

Evansville Syncline.—As mentioned above, the Ligonier Basin splits into two limbs at Newburg, Preston county. The writer has given the name Evansville to the limb bearing southward via Evansville and Dent. A glance at Map II will show that the two limbs are separated by the nose of the Hiram anticline. Although this syncline is located entirely without the three counties under discussion, yet its axis and configuration are given on Map II in order to show the split in the general basin at Newburg.

CHAPTER IV.

STRATIGRAPHY—GENERAL SECTIONS.

Introduction.

Geologists have classified the sedimentary or stratified rocks of the earth's surface into divisions based mostly on the animal and vegetable life of the past ages as preserved in a fossil state in the rocks themselves. The following are the principal divisions of the rock column as now generally recognized:

Cenozoic—Recent life forms.
Mesozoic—Less recent life forms
Paleozoic—Oldest forms of life.
Archean—Generally crystalline rocks without fossils, and direct evidence of life largely destroyed.

The cropping rocks in West Virginia are mostly included in the Paleozoic division, and by far the greater portion of the surface of the State is covered with rocks belonging to one subdivision of this era, viz., the Carboniferous.

The subdivisions or ages of the Paleozoic are:

Carboniferous { Upper { Permian, or Permo-Carboniferous. / Coal Measures, or Pennsylvanian. / Lower—Subcarboniferous, or Mississippian.

Devonian.
Silurian.
Ordovician.
Cambrian.

In the three counties under discussion, the cropping rocks belong almost wholly in the Carboniferous, and include the topmost beds of the Dunkard down to the Berea Grit at the very base of the Subcarboniferous, or Mississippian. Where

the Chestnut Ridge Arch crosses Cheat river in eastern Monongalia, probably 50 to 100 feet of the top of the Devonian crops along both banks of the stream. The following exhibits the several subdivisions of the stratified rocks in northern West Virginia:

Upper Carboniferous (2300 to 2800 feet):
Dunkard, or Permo-Carboniferous Series (1100 to 1200 feet).
Monongahela Series (260 to 400 feet).
Conemaugh Series (500 to 600 feet).
Allegheny Series (225 to 350 feet).
Pottsville Series (250 to 300 feet).

Lower Carboniferous (450 to 1000 feet):
Mauch Chunk Shales (40 to 250 feet).
Greenbrier Limestone (15 to 150 feet).
Pocono Sandstones (400 to 600 feet).

Devonian (Only about 100 feet of the top crops in Monongalia-Marion-Taylor Area):
Catskill Sandstones (Venango Oil Group, 300 to 500 feet).
Chemung and Hamilton Shales, penetrated in Wheeling deep well to a depth of nearly 2000 feet below the Venango Oil Sand Group without reaching the Corniferous limestone which probably lies over 6000 feet below the Pittsburgh coal in even the most western portions of this area, and several thousand feet more in the most eastern portion.

In order to illustrate the succession and character of the several formations of the rock column in the Monongalia-Marion-Taylor area, several sections will be given that have been made both from exposure at crop, and from the logs of numerous borings for coal, petroleum and natural gas throughout the three counties.

MONONGALIA COUNTY SECTIONS.

BATTELLE DISTRICT.—The following section was obtained in the northwest corner of Battelle district by combining a hand-leveled section, measured from the summit of Honsocker Knob near St. Cloud eastward along the ridge and hill road, with the log of the James L. White No. 1 well (7), located on Brushy fork, one mile eastward from St. Cloud. A portion of the section was measured down the hill road leading northeast to the S. L. Spragg No. 1 well (4). The log is as furnished James L. White by a driller on well:

Section Near St. Cloud, Battelle District.

Upper Carboniferous (2504')	Thickness. Feet.	Total. Feet.	
Dunkard Series (1066')			
Sandstone, flaggy, from top Honsocker Knob, Upper Proctor	37	37	
Concealed along bench	7	44	
Sandstone, forming bluff, Middle Proctor	20	64	
Concealed along bench	5	69	
Sandstone, massive, green, micaceous, Lower Proctor	20	89	
Concealed	21	110	
Shale, reddish and variegated	5	115	
Sandstone, massive, St. Cloud	18	133	
Shale, sandy	4.7	137.7	
Coal, slaty, Windy Gap	0.3	138	138'
Fire clay and shaly sandstone	8	146	
Shale, sandy	4	150	
Fire clay	5	155	
Shale, red and variegated	22	177	
Concealed to road fork (U. S. G. S. 1466' A. T. on map)	5	182	
Shale, sandy	12.7	194.7	
Shale, coaly, Gilmore	0.3	195	57'
Fire clay shale	0.3	195.3	
Limestone, gray and hard, weathered yellowish, Gilmore	1	196.3	
Shale, gray	1.7	198	
Shale, sandy	5	203	
Concealed	10	213	
Sandstone, flaggy and shaly	11	224	
Shale, red and concealed	8	232	
Shale, red and variegated	11	243	
Concealed	12	255	
Shale, gray	2	257	
Sandstone, massive	26	283	
Shale, red	4	287	
Sandstone, flaggy and shaly	15	302	
Shale, reddish	7	309	
Shale, limy and gray	2	311	
Limestone, gray and hard	1	312	
Shale, variegated and red	11	323	
Shale, red and silicious	5	328	
Sandstone, Taylor	23	351	
Fire clay shale	3	354	
Shale, buff, sandy	14	368	
Sandstone	2	370	
Concealed	10	380	185'
Coal, slaty, Nineveh "A"	0.2	380.2	
Limestone, shaly and silicious, Lower Rockport	8.8	389	
Shale, brown and silicious	2.8	391.8	
Shale, black	0.2	392	
Shale, gray and variegated	13	405	
Sandstone, shaly, Nineveh, to level Jas. L. White well (7)	19	424	

	Thickness Feet.	Total Feet.	
Jas. L. White No. 1 Well Log (7).			
Sandstone, not recorded, supplied from crop	4	428	
Coal, Nineveh, not " " " "	1	429	49′
Slate, black, " " " " "	1	430	
Fire clay shale " " " " "	2	432	
Limestone, gray and hard, in layers, Nineveh	5	437	
Unrecorded	629	1066	637′
Monongahela Series (350′)			
Unrecorded	183	1249	
Lime	64	1313	
Coal, Mapletown, Sewickley	6	1319	
Slate	89	1408	
Coal, Pittsburgh	8	1416	350′
Conemaugh Series (550′)			
Unrecorded	482	1898	
Sand, (I Cow Run) (Buffalo)	20	1918	
Slate	48	1966	550′
Allegheny Series (259′)			
Slate	103	2069	
Gas sand (Lower Freeport)	98	2167	
Slate, black	10	2177	
Limestone	6	2183	
Slate	42	2225	259′
Pottsville Series (279′)			
Sand, Salt? (II Cow Run and Salt)	83	2308	
Break of slate	4	2312	
Sand, Salt	22	2334	
Slate	95	2429	
Sand, Maxton?	25	2454	
Slate, black	50	2504	279′
Lower Carboniferous (779′) .			
Mauch Chunk Series (128′)			
Slate, black	35	2539	
Red rock	46	2585	
Slate	47	2632	128′
Greenbrier Limestone (74′)			
Big Lime	74	2706	74′
Pocono Sandstones (577′)			
Sand, open, Big Injun (Keener)	58	2764	
Slate, black	10	2774	
Sand, Big Injun	140	2914	
Slate	70	2984	
Sand, Squaw	40	3024	
Slate	192	3216	
Sand, open, Thirty-foot? (Berea)	67	3283	577
Devonian (651′)			
Catskill Sandstones (651′)			
Slate	91	3374	
Sand, Fifty-foot (Gantz and Fifty-foot)	135	3509	
Slate	5	3514	
Red rock	10	3524	
Sand, white, (Thirty-foot)	20	3544	
Slate	15	3559	
Unrecorded	100	3659	376′

	Thickness Feet.	Total Feet.	
Sand, Gordon	12	3671	
Slate	29	3700	
Sand, Fourth	10	3710	
Slate and shale (202'?)	132	3842	183'
Sand, Bayard	8	3850	
Unrecorded to bottom	84	3934	92'

(10" casing, 521'; 8¼" casing, 1482'; and 6⅝" casing. Abandoned as dry hole.)

Owing to a slight rise in the rocks in the direction the hand-leveled portion of the section was measured, 20 to 30 feet will have to be added to the total for the Dunkard series, giving these measures a thickness of about 1090 feet, the maximum obtained for the Monongalia-Marion-Taylor area.

The following section was obtained by using portions of the logs of the Elihu Eddy No. 6 well (81) and the Samuel Eakin No. 1 well (90) in connection with a hand-leveled section measured eastward down the hill road to Crossroads in the eastern part of Battelle district. The three formations at the top were measured with aneroid from the summit of a high knob, located a mile and a third south about 70° east from Crossroads, and the formations below, down to and including the Jollytown coal, from the summit of the high knob 0.4 mile due east of the town. The section is interesting in that three well-known coals of the Dunkard series are noted:

Section at Crossroads, Battelle District.

Upper Carboniferous (1363')	Thickness.	Total.	
Dunkard Series (988')	Feet.	Feet.	
Concealed with small sandstone boulders from top of high knob	10	10	
Sandstone, flaggy, green forms bluff, Lower Proctor	35	45	
Concealed along bench to geologic level of summit of knob 0.4 mile east of Crossroads	15	60	
Sandstone, massive, not exposed at latter knob	25	85	
Sandstone, massive, green, micaceous, forms bluff, Gilmore	35	120	120'
Concealed	92	212	
Shale, green	5	217	
Sandstone, massive, green micaceous, Taylor	32	249	129'
Shale	5	254	
Concealed	22	276	
Sandstone, green, broken and shaly	10	286	
Concealed	15	301	

	Thickness Feet.	Total Feet.	
Sandstone, massive	10	311	
Concealed with reds	16	327	
Limestone, gray and hard, Nineveh	1	328	79′
Sandstone, massive, medium grained, green, micaceous, Burton	40	368	
Concealed	32	400	
Fire clay shale (Hostetter coal horizon at top)	10	410	82′
Shale, red	5	415	
Sandstone, massive	19	434	
Fire clay shale with iron ore nuggets	7	441	
Sandstone, shaly, Fish Creek	20	461	
Concealed	5	466	
Coal, slaty, Fish Creek	0.3	466.3	56.3′
Fire clay shale	3.7	470	
Concealed	7	477	
Sandstone, with shale layers, Rush Run	26	503	
Shale, buff, sandy	10	513	
Coal, slaty....0—1 Shale, gray....0—5 } Dunkard (1120′B-A. T.) Coal .....0—6	1	514	47.7′
Fire clay shale and sandstone	5	519	
Concealed	5	524	
Shale	5	529	
Concealed	5	534	
Sandstone, massive, Jollytown	37	571	
Shale	5	576	
Coal .....1′—4″ Shale, gray....0—4 } Jollytown, 1.7 to..... Coal, slaty. 0—3 (1055′B-A. T.)	2	578	64′
Unrecorded in Elihu Eddy No. 6 Well (81)	410	988	410′
Monongahela Series (375′)			
Coal, Waynesburg, supplied from Sam'l Eakin No. 1 well (90)	4	992	
Unrecorded in Eddy No. 6 well (81)	363	1355	
Coal, Pittsburgh	8	1363	375

CLAY DISTRICT.—Clay district, Monongalia county, lies immediately east of and adjoining Battelle district. The outcropping rocks are in the Dunkard and Monongahela series. The following section was obtained by combining the log of the Grant Stephens Diamond Drill Boring (168), located 0.2 mile east of Mooresville, with a section measured by aneroid northwestward along the hill road leading to the well. The log is as published on page 682 of Vol. II (A) of the State Geological Survey reports:

Mooresville Section, Clay District.

Upper Carboniferous (1058')	Thickness. Feet.	Total Feet.	
Dunkard Series (675')			
Concealed from top knob to road at low gap, 0.9 mile SE of Mooresville	100	100	
Concealed along road to northwest	10	110	
Sandstone, shaly	29	139	
Shale	0.7	139.7	
Coal, Fish Creek	0.3	140	140'
Fire clay and shale	5	145	
Sandstone	10	155	
Concealed	15	170	
Sandstone	10	180	
Shale, red	4	184	
Limestone, brecciated, nodular	1	185	
Concealed	10	195	
Shale, buff, with thin sandstones	20	215	
Sandstone	5	220	
Shale, buff, sandy	15	235	
Sandstone, massive, Jollytown	34	269	
Fire clay (Jollytown coal horizon)	1	270	130'
Concealed	20	290	
Sandstone, massive, Hundred	10	300	
Shale, buff and sandy	10	310	
Concealed	35	345	
Sandstone, massive	10	355	
Concealed	10	365	
Shale, red	15	380	
Sandstone, friable, Upper Marietta	20	400	
Concealed	29	429	
Fire clay (Washington "A" coal horizon)	1	430	160'
Shale	5	435	
Sandstone and shale	5	440	
Sandstone, massive top, shaly bottom, Lower Marietta	35	475	
Shale	5	480	
Concealed	37	517	
Coal, Washington (1010' B-A. T.)	3	520	90'
Concealed to top Stephens coal test boring (168)	50	570	
Grant Stephens Diamond Drill Boring (168)			
Surface	10	580	
Lime	60	640	
Sandstone, Waynesburg	35	675	155'
Monongahela Series (382.2')			
Coal, Waynesburg	2.5	677.5	
Lime	78.5	756	
Shale, sandy	24	780	
Lime and shale	20	800	
Shale, sandy	10	810	
Lime	16	826	
Sand	13	839	
Shale, blue	2	841	
Lime	25	866	
Shale, blue	2	868	

	Thickness Feet.	Total Feet.	
Lime	25	893	
Shale	3	896	
Lime	9	905	
Shale, blue	8	913	
Shale	4	917	
Sand, Sewickley	45	962	
Shale, sandy	2	964	
Coal, Sewickley	7	971	296′
Lime, Sewickley	42	1013	
Lime and shale	6	1019	
Coal, Redstone	1	1020	49′
Lime, Redstone	13	1033	
Shale	7	1040	
Fire clay	2	1042	
Shale, black	3	1045	
Shale	2.5	1047.5	
Coal, Pittsburgh (9′ 9″)	9.7	1057.2	37.2′
Conemaugh Series (0.75′)			
Slate to bottom	0.75	1058	0.7′

The following section was obtained in the southeast corner of Clay district on the head of Indian creek by combining an aneroid section, measured from the summit of a high knob, 0.2 mile southward from Behler, along the hill road leading down the latter stream, with the log of the D. J. Eddy Diamond Drill Boring (211), the partial record of which was published on pages 128-129 of Vol. II of the State Survey reports. The Washington coal crops 47 feet by hand-level above the well mouth.

Section One-half Mile South of Behler, Clay District.

Upper Carboniferous (878.6′)	Thickness.	Total	
Dunkard Series (528)	Feet.	Feet.	
Concealed from top of knob	50	50	
Shale	5	55	
Sandstone, massive, Fish Creek	30	85	
Shale	4.8	89.5	
Coal, Fish Creek, (1395′ B-A. T.)	0.2	90	90′
Fire clay shale, typical, Fish Creek	10	100	
Concealed	54.8	154.8	
Coal, Jollytown	0.2	155	65′
Shale	5	160	
Sandstone	3	163	
Concealed, red shale and sandstone	62	225	
Shale, buff	15	240	
Concealed and shale	25	265	
Sandstone, flaggy	2	267	
Shale, buff reddish, with thin sandstones	28	295	
Concealed	57	352	

	Thickness Feet.	Total Feet.	
Coal, Washington (concealed, thickness estimated)	3	355	200′
Concealed (hand-level measurement) to boring (211)	47	402	
D. J. Eddy Boring Record (311).			
Unrecorded	126	528	173′
Monongahela Series (350.6′)			
Coal .....0′ 6″			
Shale .....1 3 } Waynesburg coal	7.6	535.6	
Coal 5 10			
Shale (1′ 5″)	1.4	537	
Shale with streaks of lime	3	540	
Sand shells	23	563	
Limestone, Waynesburg	7	570	42′
Sand shells	7	577	
Sand	16	593	
Shale	6	599	
Lime	1	600	
Sand shells	9	609	
Sand	3	612	
Sand shells	9	621	
Lime	10.5	631.5	
Sand shells	13	644.5	
Lime	30.5	675	
Shale, blue	2.5	677.5	
Lime	14.5	692	
Shale	5	697	
Shale, black	1	698	
Lime	9	707	
Sand	5	712	
Lime	14	726	
Lime shells	6	732	
Sand, Sewickley	53.5	785.5	
Coal Sewickley (6′ 8″)	6.7	792.2	222.2′
Shale (4′ 10″)	4.8	797	
Lime shells	2	799	
Lime ..... 3′ 0″			
Lime shells... 1 0			
Lime 8 0			
Soft shells.... 2 0 } Sewickley Limestone	34	833	
Shells 2 0			
Lime 18 0			
Lime shells	5	838	
Soft shells	3	841	48.8′
Coal, Redstone	1	842	
Slate, black	14	856	
Sand shells	1	857	
Lime, Redstone	1	858	
Blue shale	7	865	
Black shale	4.5	869.5	
Coal, "roof"....1′ 6″ } (9′ 1″) Pittsburgh	9.1	818.6	37.6′
Coal .....7 7 }			

The above section shows the thickness of the Monongahela series in this region to be only 350.6 feet, or 5 feet less

than given (355′ 7″) in Vol. II above mentioned. The writer thinks that the coal at 89.8 feet from the top represents the Fish Creek bed of the Dunkard series, since it is accompanied by its characteristic fire clay shale. Owing to the rapid rise in the strata in the direction the section was measured, the intervals above the Washington coal are all shorter than they should be, especially between the Fish Creek and Jollytown coals.

CASS DISTRICT.—Cass district lies immediately to the east of Clay, and is bounded on the north by Pennsylvania, and on the east by the Monongahela river. Its outcropping rocks are in the Dunkard, Monongahela and Conemaugh series. D. B. Reger measured the following hand-leveled section from the top of a knob eastward down the river hill at a point 0.2 mile southward from Jimtown (Randall), in the southeast corner of Cass district:

Section at Randall (Jimtown), Cass District.

Upper Carboniferous (463′)	Thickness. Feet.	Total. Feet.	
Monongahela Series (297′)			
Concealed from top of knob	44	44	
Sandstone, flaggy, gray	18	62	
Concealed	9	71	
Slate, black (Lower Uniontown coal horizon)	0	71	71′
Limestone, hard	12	83	
Concealed	12	95	
Sandstone	5	100	
Concealed, limestone, and concealed	72	172	
Sandstone, gray, flaggy, Sewickley	23	195	
Coal, Sewickley, (4′ 2″)	4	199	128′
Concealed	10	209	
Sandstone, shaly	23	232	
Limestone and concealed	29	261	
Coal, good....3′ 1½″			
Slate, black...0 0¼ } **Redstone coal**	6	267	68′
Coal, good ...2 10¼			
Limestone, hard, Redstone	15	282	
Slate, black	7	289	
Coal, Pittsburgh	8	297	30′
Conemaugh Series (166′)			
Concealed and limy shale	16	313	
Limestone, hard	6	319	
Sandstone, hard, gray, Lower Pittsburgh	20	339	
Shale, limy, with nodules of carbonate of iron at top	15	354	
Shale, dark	1	355	
Shale, limy	4	359	

	Thickness. Feet.	Total. Feet.	
Limestone, hard, Upper Pittsburgh	5	364	
Shale, limy and hard	12	376	
Limestone, shaly	5	381	
Shale, gray and hard	6.3	387.3	
Coal (8"), Little Pittsburgh	0.7	388	91′
Sandstone, shaly	12	400	
Slate, black	1	401	
Limestone, hard, Lower Pittsburgh	1.5	402.5	
Slate, black	1.5	404	
Shale, gray and hard	5	409	
Limestone, hard	3	412	
Shale, hard, limy	8	420	
Shale, dark	1	421	
Sandstone, massive, Connellsville	10	431	
Coal (8" to 12"), Little Clarksburg	1	432	44
Limestone, hard, Clarksburg	12	444	
Concealed to Pool No. 9 level, river at Jimtown (793.4′ L-A. T.)	19	463	31′

The following section was obtained in the southwestern point of Cass district, the most of which is included in the log of the David Henderson No. 1 gas well (269), drilled by the Union Utility Company in November, 1908, and located a mile and a third south 75° to 80° west of Cassville:

Section 1.3 Miles West of Cassville, Cass District.

Upper Carboniferous (2059′)	Thickness.	Total.	
Dunkard Series (567′)	Feet.	Feet.	
Concealed from top of knob near district line	260	260	260′
David Henderson No. 1 Well Record (269).			
Surface gravel (conductor)	18	278	
Slate	55	333	
Sand	28	361	
Slate and shells	70	431	
Lime	8	439	
Slate	55	494	
Sand (Waynesburg), (Bluff)	61	555	
Slate, (Cassville Plant Shale)	12	567	307′
Monongahela Series (384′)			
Coal, (Waynesburg)	5	572	
Slate and shells	16	588	
Lime	13	601	
Slate	19	620	
Lime	23	643	
Slate and shells	18	661	
Lime	11	672	
Slate	8	680	
Lime	12	692	
Slate	9	701	
Lime	13	714	

	Thickness. Feet.	Total. Feet.	
Slate and shells	26	740	
Lime and sand	24	764	
Slate	18	782	
Lime and sand	17	799	
Slate	20	819	
Lime	12	831	
Slate	15	846	
Coal, (Sewickley)	6	852	285'
Lime	16	868	
Slate	17	885	
Lime	18	903	
Slate	11	914	
Lime	17	931	
Limy sand	12	943	
Coal, (Pittsburgh)	8	951	99'
Conemaugh Series (585')			
Slate and shells	28	979	
Coal, (Little Pittsburgh)	4	983	
Lime shells	30	1013	
Slate	65	1078	
Sand	45	1123	
Slate and shells	90	1213	
Red rock	65	1278	
Slate and shells	70	1348	
Sand and lime	15	1363	
Slate	30	1393	
Red rock	55	1448	
Sand, (Buffalo)	43	1491	
Slate	45	1536	585'
Allegheny Series (252')			
Sand, (Upper Freeport)	60	1596	
Slate	12	1608	
Sand	23	1631	
Slate and shells	14	1645	
Sand, (Lower Freeport)	30	1675	139'
Slate	57	1732	
Limy sand	32	1764	
Slate	24	1788	113'
Pottsville Series (271')			
Sand	12	1800	
Slate	6	1806	
Sand	145	1951	
Slate	13	1964	
Sand	40	2004	
Slate and shells	55	2059	271'
Lower Carboniferous (638')			
Mauch Chunk Series (117')			
Red rock	26	2085	
Slate and shells	37	2122	
Red rock	30	2152	
Slate	9	2161	
Lime	8	2169	
Slate, black	7	2176	117'
Greenbrier Limestone (60')			
Big Lime	60	2236	60'

	Thickness. Feet.	Total. Feet.	
Pocono Sandstones (461′)			
Sand, Big Injun (gas at 2010′ and 2040′)....	139	2375	
Slate and shells.....	30	2405	
Sand, Squaw.....	32	2437	
Slate	135	2572	
Sand .....80′ / Limy sand....45 } (Berea)	125	2697	461′
Devonian (886′)			
Catskill Sandstones (839′)			
Slate and shells.....	90	2787	
Sand, (Gantz).....	60	2847	
Slate	15	2862	
Sand, (Fifty-foot).....	40	2902	
Red rock.....	30	2932	
(Sand)	40	2972	
Red rock	85	3057	360′
(Sand), (Gordon).....	40	3097	
Slate	30	3127	
(Sand), (Fourth).....	93	3220	
Red rock.....	70	3290	233′
Sand, Fifth (gas, 46′ in sand).....	55	3345	
Slate	25	3370	
Slate and shells.....	28	3398	98′
Sand, (Bayard or Sixth).....	58	3456	
Slate	23	3479	
Sand, (Elizabeth or Seventh).....	57	3536	138′
Chemung (47′)			
Slate and lime to bottom.....(147?).	47	3583	47′

GRANT DISTRICT.—Grant district, Monongalia county, lies south of Cass district, and is bounded on the east by the Monongahela river. The outcropping strata therein are included wholly within the Dunkard, Monongahela, Conemaugh and Allegheny series. The Cassville section on a preceding page illustrates the rock succession in the northern portion of the district. In the southern portion, the following hand-leveled section was measured southwestward along the hill road to the Monongahela river at the mouth of Flaggy Meadow run. The intervals above the Elk Lick coal are slightly less than they should be, owing to the rise in the rocks to the southeast:

Section One Mile Southeast of Beechwood, Grant District.

Upper Carboniferous (417')	Thickness. Feet.	Total. Feet.	
Monongahela Series (67')			
Coal, along hill road	52	52	
Sandstone, soft, coarse brown, Upper Pittsburgh	10	62	
Coal, Pittsburgh (thickness concealed)	5	67	67'
Conemaugh Series (350')			
Concealed	20	87	
Coal, blossom, Little Pittsburgh	1	88	
Concealed	57	145	
Shale, buff	5	150	
Sandstone, coarse, brown and pebbly, Connellsville	35	185	118'
Concealed	5	190	
Shale, sandy and buff	7	197	
Sandstone, buff, medium grained, Lower Connellsville	22	219	
Shale, gray and soft	6	225	
Shale, red, with limestone nuggets	15	240	
Fire clay shale	10	250	
Sandstone, shaly, Morgantown	29	279	
Shale	0.6	279.6	
Coal (5"), Elk Lick (974' L-A. T.)	0.4	280	95'
Fire clay shale, typical	8	288	
Concealed	14	302	
Sandstone, massive, coarse, gray and pebbly.....10' / Fire clay, brown and white 5 / **Sandstone, massive, coarse, gray and pebbly**.....17 — **Grafton Sandstone**	32	334	
Concealed	4	338	
Limestone, shaly, silicious, fossil shells, Ames	21	359	
Shale, dark	4	363	
Coal, Harlem (12" to 14") (890'L-A. T.)	1	364	84'
Concealed to river at mouth of Flaggy Meadow run	53	417	53'

UNION DISTRICT.—Union district occupies that portion of Monongalia county lying east of the river, and adjoining the State of Pennsylvania. The following section was obtained along the northwestern border of the district by combining a spirit-leveled section, measured northward down the hill road to Van Voorhis, with the log of a diamond drill boring at that place, published on pages 590-591 of Vol. II(A) of the State Survey reports. The writer has indicated in parentheses changes in correlation of the coals from that as published in the report above mentioned:

Section at Van Voorhis, Union district.

Upper Carboniferous (626′ 9″)	Thickness. Feet.	In.	Total. Feet.	In.	
Conemaugh Series (532′ 4″)					
Sandstone, coarse, brown, large quartz pebbles, Lower Pittsburgh	24	0	24	0	
Coal blossom, Little Pittsburgh (1105′ L-A. T.)	1	0	25	0	25′ 0″
Shale, gray and limy	10	0	35	0	
Concealed	15	0	50	0	
Sandstone, massive, Connellsville	15	0	65	0	
Concealed	83	0	148	0	
Sandstone, massive, coarse, Morgantown (top, 982′ L-A. T.)	55	0	203	0	178′
Concealed and shale	37	6	240	6	
Fire clay	0	6	241	0	
Shale, gray, limy and concealed	20	0	261	0	
Shale, dark, fossil shells, Ames	10	0	271	0	68′
Concealed to top Van Voorhis Bore Hole No. 3	49	0	320	0	49′
Bore Hole No. 3 Record (322) (810′ L-A. T.).					
Surface	12	0	332	0	
Soapstone	8	0	340	0	
Iron ore and shale	15	0	355	0	
Shale	35	0	390	0	
Red rock and green shale	25	0	415	0	
Shale	7	7	422	7	
Coal, Bakerstown? (Brush Creek)	1	1	423	8	103′ 8″
Fire clay	1	3	424	11	
Shale	9	1	434	0	
Sandy shale	1	5	435	5	
Sand	2	10	438	3	
Green sandy shale	13	6	451	9	
Green shale with lime	0	11	452	8	
Gray slate	6	2	458	10	
Shale	4	8	463	6	
Sandy shale and red rock	14	3	477	9	
Shale	1	0	478	9	
Sand, fine	3	4	482	1	
Shale	5	8	487	9	
Dark sand shale	3	2	490	11	
Sandy shale and lime	4	5	495	4	
Sandy shale	11	2	506	6	
Sand	4	3	510	9	
Slate	4	9	515	6	
Lime, dark	2	0	517	6	
Sand, fine	7	4	524	10	
Slate, Uffington	7	6	532	4	108′ 4″
Allegheny Series (94′ 5″)					
Coal, Brush Creek? (Upper Freeport)	0	5	532	9	
Fire clay	2	6	535	3	
Shale	4	1	539	4	
Sandstone, (Upper Freeport)	33	8	573	0	
Shale	4	10	577	10	
Slate	1	9	579	7	
Shale and fire clay	13	0	592	7	

	Thickness. Feet.	In.	Total. Feet.	In.	
Shale and lime	0	10	593	5	
Slate, gray	4	9	598	2	
Sandstone, gray and blue, (Lower Freeport)	14	4	612	6	
Shale and lime	2	4	614	10	
Slate, gray	4	0	618	10	
Slate, black	1	6	620	4	
Coal..0′ 4″ Bone.0 1 Coal..0 5 } Upper Kittanning coal.. Bone.0 1 Coal..2 10	3	9	624	1	91′ 9″
Slate to bottom	2	8	626	9	2′ 8″

The following section was obtained in the north central portion of Union district by combining an aneroid section measured from the summit of a high knob, a mile and two-fifths due south of Cheat Haven, Penna., eastward down the river hill, with the log of the Francis Costolo No. 1 well (326), located at the mouth of Morgan run. The well was completed in January, 1902, by Brooks Bros., of Beaver, Pa., and the log is as furnished by the owners to Thos. D. Manning, residing near the well:

Section at Mouth of Morgan Run, Union Distirct.

Upper Carboniferous (1253′)	Thickness. Feet.	Total. Feet.	
Monongahela Series (130′)			
Concealed from top of knob, 0.6 mile west of well	97	97	
Sandstone, massive, Upper Pittsburgh	25	122	
Coal, Pittsburgh	8	130	130′
Conemaugh Series (602′)			
Concealed mostly	225	355	
Coal, Elk Lick, and concealed to top of well.	125	480	
Francis Costolo No. 1 Well Record (326). (Elevation of well mouth, 808′ L-A. T.).			
Surface gravel (conductor)	32	512	
Lime	18	530	
Coal, (Bakerstown)	3	533	403′
Lime	17	550	
Slate	15	565	
Lime	15	580	
Sand, (Buffalo)	72	652	
Coal, (Brush Creek)	3	655	122′
Sand shell	3	658	
Slate (10″ casing, 182′)	4	662	
Lime	15	677	
Slate	5	682	

	Thickness. Feet.	Total. Feet.	
Sand, (gas and water at 205') (Mahoning)..	10	692	
Red rock	15	707	
Slate and shells	25	732	77'
Allegheny Series (239')			
Lime, (Upper Freeport)	25	757	
Sand, (water), (Upper Freeport)	15	772	
Slate	27	799	
Coal, Lower Freeport	8	807	70'
Slate	10	817	
Lime, Lower Freeport	8	825	
Slate (8¼" casing, 358')	15	840	
Sand, (Lower Freeport)	15	855	
Coal, Upper Kittanning	3	858	51'
Sand, white, (Lower Freeport)	72	930	
Slate	20	950	
Coal, Clarion	6	956	98'
Slate and shells	15	971	15'
Pottsville Series (282')			
Slate and shells	59	1030	
Lime	10	1040	
Coal, Upper Mercer	3	1043	72'
Sand, (Upper Connoquenessing)	47	1090	
Lime	28	1118	
Sand, Salt (Lower Connoquenessing)	40	1158	
Slate	6	1164	
Sand	5	1169	
Lime	9	1178	
Sand, (Sharon)	75	1253	210'
Lower Carboniferous (782')			
Mauch Chunk Series (177')			
Slate	29	1282	
Lime	15	1297	
Red rock	133	1430	177'
Greenbrier Limestone (85')			
Big Lime	85	1515	85'
Pocono Sandstones (520')			
Sand, Big Injun (oil show at 1110'; gas show, 1174')	333	1848	
Slate	10	1858	
Lime	82	1940	
Sand, (Berea)	95	2035	520'
Devonian (949')			
Catskill Sandstones (845')			
Slate	10	2045	
Sand and shells	35	2080	
Sand, (Gantz)	50	2030	
Slate	5	2135	100'
Sand, Fifty-foot	55	2190	
Slate and shells	80	2270	
Red sand, (Thirty-foot)	35	2305	
Slate	28	2333	
Red sand, (Gordon Stray)	40	2373	
Slate	24	2397	362'
Sand, Gordon	8	2405	
Red rock	145	2550	

	Thickness. Feet.	Total. Feet.	
Sand, (Fourth)	10	2560	
Red rock	35	2595	198′
Sand, (Fifth)	10	2605	
Slate	60	2665	
Shells	10	2675	
Slate	15	2690	95′
Sand, (Bayard or Sixth) and shells	25	2715	
Slate	55	2770	
Slate and shells	30	2800	
Slate	80	2880	190′
Chemung Series (104′)			
Lime	10	2890	
Slate	90	2980	
Lime	4	2984	104′

The following aneroid section was measured southward down the east hillside of Cheat river to the bed of that stream a short distance above the Mont Chateau Hotel. The thickness of formations and intervals are only approximate, owing to the very rapid dip of the strata to the northwest:

Mont Chateau Hotel Section, Union District.

Upper Carboniferous (580′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (135′)			
Sandstone, massive, large quartz pebbles, Buffalo	60	60	
Concealed, with old clay or iron ore diggings at base	10	70	
Concealed (steep bluff) to bench	65	135	135′
Allegheny Series (240′)			
Coal, Upper Freeport	5	140	
Concealed to public road, 0.2 mile north of hotel	59.4	199.4	
Coal, (7″), Lower Freeport (1220′ L-A. T.)	0.6	200	65′
Concealed	175	375	175′
Pottsville Series (205′)			
Sandstone, massive, forms vertical cliff, Homewood	30	405	
Concealed	45	450	
Sandstone, massive, pebbly and white, forms great cliff, Upper Connoquenessing	60	510	
Concealed to Cheat river just above Mt. Chateau Hotel	70	580	205′

The following section was taken from a paper read by I. C. White before the American Philosophical Society on October 20, 1882. It was measured with aneroid in descending order to the river along the right bank of Quarry run, 0.3 mile

southeastward from the Mont Chateau hotel, where the latter stream cuts a fine exposure through the Pottsville measures:

Quarry Run Section, Union District.

	Thickness. Feet.	In.	Total. Feet.	In.	Intervals. Feet.
Upper Carboniferous (187.3')					
Pottsville Series (187.3')					
Sandstone, massive, Homewood, top of XII	25	0	25	0	
Concealed	40	0	65	0	
Sandstone, very massive, pebbly (Upper Connoquenessing)	75	0	140	0	
Coal .....0' 10" / Sand .....0 3 / Coal .....0 3 } Quakertown coal	1	4	141	4	141.3'
Black, slaty shale	10	0	151	4	
Sandstone, gray, massive	20	0	171	4	
Shale, with streaks of coal	1	0	172	4	31'
Sandstone, grayish white, massive, base of No. XII	15	0	187	4	15'
Lower Carboniferous and Devonian (1085')					
Mauch Chunk Series (300')					
Shale, green, containing I. O. (iron ore), top of No. XI	20	0	207	4	
Red shale	10	0	217	4	
Greenish, sandy shale and flaggy sandstone	60	0	277	4	
Concealed to mouth of old oil well boring (330A)	25	0	302	4	115'
Ley Oil Well Boring Record (330A). (Authority, Mr. Ley, Asst. Driller on well).					
Flaggy sandstone and shale	185	0	487	4	185'
Greenbrier Limestone (85')					
Limestone, Umbral, Mountain, etc.	85	0	572	4	
Pocono Sandstones and Catskill Sandstones (700')					
Sandstone, Vespertine, No. X (Big Injun, etc.) to bottom of hole	700	0	1272	4	

It is quite probable that Mr. Ley's memory was faulty in reporting 700 feet of sandstone at the horizon of the Big Injun sand of the oil well drillers, since no such sand mass has ever been reported in the thousands of other wells penetrating this horizon in the State.

Passing southeastward up the Cheat river gorge 2.5 miles to near where the axis of the Chestnut Ridge anticline crosses the latter stream, the following section, as published by I. C. White in the last paper above mentioned, is exposed on the east hillside of Cheat River, nearly opposite "Cheat View" as shown on Maps I and II. The section was measured with aneroid, and slight modifications therein are indicated by the writer in parentheses:

Section Opposite Cheat View, Union District.

Upper Carboniferous (185′)	Thickness. Feet.	Total. Feet.	
Pottsville Series (185′)			
Massive pebbly sandstone (Upper Connoquenessing)	150	150	
Shale and shaly sandstone, buff	35	185	185′
Lower Carboniferous (929′)			
Mauch Chunk Series (299′)			
Shale, greenish and sandy	30	215	
Sandstone, greenish gray, flaggy	90	305	
Red and green shale	12	317	
Sandstone, greenish, massive at top, flaggy and shaly below	65	382	
Brecciated limestone	2	384	
Red and green shales	25	409	
Blue sandy shale, and green flaggy sandstone.	25	434	
Limestone, impure, fossiliferous	10	444	
Red and green shale and sandstone	40	484	299′
Greenbrier, "Mountain," Limestone (110′)			
Massive limestone in layers 1′-5′ thick, sparingly fossiliferous	25	509	
Shaly limestone and calcareous shale, very fossiliferous, especially rich in Productus, Spirifer, Athyris, Lophophyllum and Crinoidal columns	5	514	
Limestone, gray, good, few fossils	45	559	
Shale and limestone	35	594	110′
Pocono Sandstones (520′)			
"Silicious limestone," passing gradually into sandstone below	30	624	
Sandstone, massive, pebbly, current-bedded, making cliffs (Big Injun)	100	724	
Concealed	390	1114	520′
Devonian (85′)			
Catskill Sandstones (85′)			
Concealed to level of Cheat river (860′ B-A. T.)	85	1199	85′

The thickness of the Pocono sandstones as revealed by the Morgan Run Section on a preceding page is only 520 feet; hence, the writer has placed 85 feet of the concealed interval in the Catskill.

The following hand-leveled section was measured near the southeastern border of Union district northward down the mountain road to Cheat river level at Beaverhole Owing to the rapid dip of the rocks to the southeast at this point, the thickness of formations and intervals are only approximate, especially in that portion of the section from the base of the Allegheny series down to the top of the Pocono sandstones.

Beaverhole Section, Valley District, Preston County.

Upper Carboniferous (1189')	Thickness. Feet.	Total. Feet.	
Allegheny Series (271')			
Concealed from summit of hill road 1 mile S 45° W of Beaverhole	40	40	
Shale	5	45	
Coal (20"), Lower Freeport (2014' L-A. T.)	1.7	46.7	46.7'
Shale	5.3	52	
Concealed	25	77	
Sandstone, massive, Lower Freeport, upper division	37	114	
Concealed	15	129	
Sandstone, massive, gray, hard, and pebbly, Lower Freeport	89	218	
Concealed	22	240	
Sandstone, massive	10	250	
Shale	6	256	
Coal .....3' 0" / Slate, gray.1 0 / Coal .....1 0 — **Clarion coal (1800' L-A. T.)**	5	261	214.3'
Concealed	10	271	10'
Pottsville Series (314')			
Sandstone, massive, Homewood	40	311	
Concealed	40	351	90'
Sandstone, massive, great cliff rock, Upper Connoquenessing	100	451	
Concealed and sandstone	62	513	
Sandstone, gray and white, coarse and pebbly, Sharon	62	575	224'
Lower Carboniferous (676')			
Mauch Chunk Series (226')			
Concealed with sandstone boulders	42	617	
Concealed with brown and green sandstone	104	721	
Sandstone, massive, brown, fine grained	21	742	
Concealed	5	747	
Sandstone, massive, coarse, gray and white, and pebbly, Maxton	42	789	
Concealed to road forks (U. S. G. S. 1260' L-A. T.)	12	801	226'
Greenbrier Limestone (92')			
Concealed	61	862	
Limestone, dark gray, "Big Lime"	31	893	92'
Pocono Sandstones (296') (top, 1168'L-A. T.)			
Sandstone, massive, coarse and pebbly, gray and brown, Big Injun	73	966	
Concealed	203	1169	
Sandstone, bluish green, flaggy, Upper Squaw, to Cheat river level at Beaverhole (872' L-A. T.)	20	1189	296'

The following section was measured with aneroid by D. B. Reger from the summit of the hill at the residence of Emory Cale, about one mile north 32° east of Rohr, north-

ward down a run leading into Cheat river one mile below Beaverhole. The intervals are slightly less than they should be, owing to the rise of the strata in the direction of the section:

Section Two Miles North of Rohr, Union District.

	Thickness. Feet.	Total. Feet.	
Upper Carboniferous (320')			
Pottsville Series (320')			
Concealed, mostly sandstone, from summit of hill near residence of Emory Cale	45	45	
Coal blossom, Tionesta?	..	45	
Concealed	60	105	
Sandstone, massive, grayish white, pebbly 95' thick by hand-level), Upper Connoquenessing	95	200	
Concealed	120	320	320'
Lower Carboniferous (835')			
Mauch Chunk and Greenbrier Limestone (316')			
Sandstone, fine grained, flaggy, micaceous	25	345	
Concealed	225	570	
Limestone, gray and hard (hand-level measurement), Greenbrier	66	636	316'
Pocono Sandstones (519')			
Sandstone, Keener (top, 1385' B-A. T.)	25	661	
Shale, red	4	665	
Sandstone, hard, gray, very limy at top, making with 60 ft. cliff exposure at base, Big Injun	105	770	
Shale, gray and limy	20	790	
Sandstone, hard, greenish gray, flaggy, fine grained	10	800	
Shale, ferriferous	10	810	
Concealed	65	875	
Sandstone, massive, hard, gray, medium grained, Squaw	125	1000	364'
Shale, gray, hard, very silicious, with iron ore nuggets	55	1055	
Sandstone, limy and hard	10	1065	
Concealed to Cheat river, mouth of run, one mile below Beaver hole (865' B-A. T.)	90	1155	155'

The following section was obtained by combining a spirit leveled section measured from the summit of the knob, 0.3 miles due west of Easton, northward, with the log of the Yost Diamond Drill Boring (319) published on pages 587-588 of Vol. II(A) of the State Survey reports. In the writer's judgment, this boring lacked 75 to 80 feet of reaching down to the Upper Freeport coal, as will appear from a study of the next two sections. The identifications in parentheses are corrections and additions in the log as published:

Section ½ Mile Northwest of Easton, Morgan District.

Upper Carboniferous (645.8')	Thickness. Feet.	In.	Total. Feet.	In.	
Monongahela Series (100')					
Concealed from top of knob 0.3 mile west of Easton	65	0	65	0	
Sandstone, massive, Upper Pittsburgh	25	0	90	0	
Coal, Pittsburgh (Base, 1167' L-A. T.)	10	0	100	0	100'
Conemaugh Series (545.8')					
Concealed to Yost Diamond Drill Boring	181	0	281	0	181'
Yost Boring Record (319)					
(Elevation of Well mouth, 986' L-A. T.).					
Surface	10	0	291	0	
Shale	8	0	299	0	
Sandstone, gray (Morgantown)	25	0	324	0	
Slate	1	6	325	6	
Sandstone	5	0	330	6	
Slate	1	6	332	0	
Shale and limestone	4	0	336	0	
Shale	2	0	338	0	
Slate	1	6	339	6	
Coal, (Elk Lick)	0	8	340	2	59.1'
Fire clay	1	0	341	2	
Shale	25	0	366	2	
Gray slate	15	6	381	8	
Slate	2	0	383	8	
Sandstone ....8' 0" Sandy shale.....5 4 Sandy slate.....4 0 Sandstone and coal partings...5 0 Sandstone 3 0	**(Grafton Sandstone)**		25	4	409	0	
Shale .....6' 0" Slate .....11 0 Shale ..... 2 0 Slate 4 6	**(Ames Shale)**		23	6	432	6	
Coal, (Harlem)	0	6	433	0	93.1'
Fire clay	0	6	433	6	
Sandy slate	5	6	439	0	
Green shale	7	0	446	0	
Dark shale	6	0	452	0	
Sandy shale	8	0	460	0	
Red shale, (Pittsburgh Reds)	11	0	471	0	
Sandy shale	14	0	485	0	
Green shale	15	0	500	0	
Sand, (Saltsburg)	15	0	515	0	
Shale	2	0	517	0	
Sandstone	1	6	518	6	
Fire clay, (Bakerstown coal horizon at top)	6	6	525	0	92'
Sandstone, coarse (local)	21	0	546	0	
Dark shale	4	0	550	0	
Green shale	3	0	553	0	
Sandy shale	5	0	558	0	
Sandstone, Mahoning? (Buffalo)	79	0	637	0	

	Thickness. Feet.	In.	Total. Feet.	In.	
Slate, gray, Brush Creek	3	0	640	0	
Coal ..0′ 8″ Slate .0 3 Coal ..0 7 } Upper Freeport? (Brush Creek)	1	6	641	6	116.5′
Fire clay	2	0	643	6	
Clay and limestone, Upper Freeport? to bottom	2	4	645	10	4.3′

Two miles farther down West run, another diamond drill boring (320) was sunk by H. C. Greer on the McClaren farm, the detailed record of which as published on pages 588-589 of the above mentioned report is as follows:

McClaren Bore Hole Record (320), Morgan District.

(Elevation of well, 935′ B-A. T.).

Upper Carboniferous (396′) Conemaugh Series (318.6′)	Thickness. Feet.	In.	Total. Feet.	In.	
Surface	9	0	9	0	
Green shale	15	0	24	0	
Slate	14	7	38	7	
Limestone	5	6	44	1	
Soft clay	10	9	54	10	
Limestone	5	5	60	3	
Lime shale	4	4	64	7	
Red and green shale	18	6	83	1	
Green shale	15	11	99	10	
Sandstone	6	5	105	5	
Green shale	10	3	115	8	
Limestone	1	8	117	4	
Dark shale and slate	8	11	126	3	
Limestone	1	6	127	9	
Shale and fire clay	3	10	131	7	
Slate	0	4	131	11	
Coal, Bakerstown	1	4	133	3	133.2′
Clay	2	2	135	5	
Slate and shale	2	8	138	1	
Sandstone	15	8	153	9	
Shale	9	5	163	2	
Fire clay	2	2	166	4	
Red and green shale	2	9	169	1	
Sandstone	1	4	170	5	
Red and green shale	3	2	173	7	
Sand, slate and lime	8	9	182	4	
Sandy shale	20	1	202	5	
Slate	14	4	216	9	
Limestone, Brush Creek	2	0	218	9	
Sandstone	4	3	223	0	
Sandy slate	5	4	228	4	
Black slate, Brush Creek	2	6	230	10	
Coal .....2″ Slate .....4 Coal .....6 } Brush Creek Coal....	1	0	231	10	98.6′

	Thickness. Feet.	In.	Total. Feet.	In.	
Fire clay	19	9	251	7	
Limestone	1	8	253	3	
Shale	3	2	256	5	
Sand and slate	13	4	269	9	
Black shale	1	3	271	0	
Fire clay	2	4	273	4	
Shale	4	6	277	10	
Fire clay and shale	10	6	288	4	
Sandstone	26	0	314	4	
Sandy slate	1	0	315	4	
Slate	1	8	317	0	
Slate and bone	0	2	317	2	
Fire clay	1	2	318	4	
Slate	0	3	318	7	86.8′
Allegheny Series (77.4′)					
Coal .....10″ Bone ..... 1 } Coal, Upper Freeport Coal 1	1	2	319	9	
Fire clay	5	1	324	10	
Slate	4	0	328	10	
Fire clay	3	3	332	1	
Sandy slate	33	0	365	1	
Sandstone	15	5	380	6	
Shale and slate	5	6	386	0	
Shale	6	0	392	0	
Limestone	1	0	393	0	
Fire clay	3	0	396	0	77.4′

A. D. Minney, Driller.

This boring starts 290 feet below the horizon of the Pittsburgh coal; hence, the Bakerstown, Brush Creek and Upper Freeport coals have been correctly identified in Vol. II(A). According to this record, the Yost boring lacked 82 feet of reaching the base of the Conemaugh series.

The following section was obtained for the vicinity of Morgantown by combining a hand-leveled section measured along the steep valley walls on the west side of the river with the log of the Madeira Hotel Water Well (331), the record of which was kindly furnished by Madeira Bros., the owners. In this well the top of the Buffalo sandstone was struck at a depth of 21 feet; hence, that portion of the well record above the top of this stratum is omitted, since the hand-level section extends down to the top of this sandstone. The upper 337 feet of the section, or that portion above the Elk Lick coal, was measured from the summit of the high knob, 0.8 mile due west of Scrafford, northeastward almost on the

strike of the strata, along the hill road via the quarry in what was heretofore supposed to be the true Connellsville sandstone; and that portion from the Elk Lick coal down to the top of the Buffalo sandstone was measured down the steep river hill northward from Lock No. 10. The Elk Lick-Bakerstown coal interval is 1 foot less than in the accurate Sabraton section as published on page 628 of Vol. II(A) of the State Survey reports. The Pittsburgh coal misses the high knobs immediately north and northwest of Lock No. 10. The section shows that the quarry rock near the summit of the hill, northwest of Scrafford, represents the Lower Connellsville sandstone and not the regular Connellsville as described on page 247 of Vol II of the State Survey reports:

Morgantown Section, Grant and Morgan Districts.

	Thickness Feet.	Total Feet.	
Upper Carboniferous (1144')			
Monongahela Series (95')			
Concealed from summit of knob 0.8 mile West of Scrafford	57	57	
Sandstone, massive, Upper Pittsburgh	30	87	
Coal, Pittsburgh	8	95	95'
Conemaugh Series (605.5')			
Concealed and shale	40	135	
Coal .....0' 9" Shale, gray.0 3 } Little Pittsburgh coal **Coal** 1 0	2	137	
Fire clay shale	8.4	145.4	
Coal, shaly	0.1	145.5	
Fire clay shale	5.5	151	
Concealed and gray shale	26	177	
Sandstone, massive, coarse, brown and pebbly, at bottom, medium grained top, Connellsville	52	229	134'
Shale	1	230	
Concealed (should hold **Little Clarksburg coal**)	19	249	
Shale	1	250	
Sandstone, flaggy, with shale layers ..... 9.8' **Shale, bituminous** 0.2 Fire clay shale.. 0.5 Sandstone, limy, sometimes limestone ..... 1.3 **Sandstone, massive. coarse, mottled with peroxide of iron, quarry rock...21.6**	Lower Connellsville. 33.4	283.4	

	Thickness. Feet.	Total. Feet.	
Concealed	24.6	308	
Shale, reddish, sandy, forms steep bluff (Morgantown sandstone horizon)	26	334	
Concealed and shale	3	337	
Coal, Elk Lick	1	338	54.6′
Fire clay shale	5	343	
Concealed (should contain Elk Lick limestone)	13	356	
Shale, reddish, sandy	30	386	
Shale	3	389	
Limestone, ferriferous, nodular	1	390	
Shale, red	10	400	
Sandstone, limy and hard	1	401	
Shale, buff	11	412	
Concealed	16	428	
Limestone, shaly, silicious, marine fossils prolific, Lower Ames (975′ L-A. T.)	9	437	
Coal, Harlem	1	438	100′
Concealed, (Mostly along old river terrace)	52	490	
Concealed and red shale, (Pittsburgh)	20	510	
Sandstone, massive, greenish, micaceous, Saltsburg	12	522	
Shale, sandy	5	527	89′
Fire clay shale (Bakerstown coal horizon at top)	5	532	
Shale, weathering reddish, sandy	10	542	
Limestone, silicious, hard, Pine Creek	1	543	
Shale, brown, sandy to top of Buffalo sandstone	2	545	
Madeira Hotel Water Well Record (331). (Except first 21 feet which is included in section above.)			
Sandstone, top 21 feet below well mouth, with small stream of water at 35′....53′ / Boulders and shelly rock... 8 / Sandstone .....28 (Buffalo).	89	634	
Fire clay or white wash (Brush Creek coal horizon)	1	635	108′
Sand rock, heavy, soft, blue	9	644	
Unrecorded	7	651	
Sandstone, hard, gray.22′ 0″ / Shale, sandy, dark gray .....12 0 / Sandstone, fine, very hard, gray .....15 6 (Mahoning Sandstone)	49.5	700.5	65.5′
Allegheny Series (238.5′)			
Coal and slate, "rider"....5′ / Shale, sandy, dark gray..15 / Coal ..... 4 (Upper Freeport Coal..	24	724.5	
Sandstone, limy streaks..42′ / Sandstone, shaly.....12 / Sandstone, hard and gray.23 (Upper Freeport Sandstone)	77	801.5	
Coal and slate, Lower Freeport	0.5	802	101.5′

		Thickness. Feet.	Total. Feet.	
Sandstone and gray sandy shale.....30' Sandstone, gray, soft. shaly..... 7 Sandstone, hard, grayish white....30 Sandstone, limy streaks 8	(Lower Freeport Sandstone)	75	877	
Shale, gray.....		10	887	
Shale, dark gray.....		17	904	
Sandstone, hard, fine gray (Clarion).....		20	924	
Coal and slate, Clarion.....		2	926	124'
Shale, sandy, dark gray.....		13	939	13'
Pottsville Series (205)				
Sandstone, coarse, mixed with slate and coal, possibly cavings, well cased in this sandstone.. 4' Sandstone, coarse, grayish white, water.....14 Shale, sandy and dark gray 8 Sandstone, hard and gray.. 5 Sandstone, hard, dark gray 8	(Homewood)	39	978	
Unrecorded		16	994	
Sandstone, white, hard, pebbly in streaks, solid, Upper Connoquenessing.....		80	1074	
Sandstone, dark shaly.....		6	1080	
Sandstone, coarse gray.....		3	1083	
Shale, sandy and dark.....		9	1092	
Sandstone, grayish white, pebbly.....26' Sandstone, shaly, dark.10 Sandstone, gray, hard and pebbly to bottom of well.....16	Lower Connoquenessing? ..	52	1144	205

The following section was obtained in the north edge of Sabraton by combining the log of the churn drill coal test Bore Hole No. 5 (334) of the American Sheet & Tin Plate Co., located a few hundred feet northward from the M. & K. R. R. shops near the trolley car line trestle, with a section measured from the summit of the hill one-half mile northeast of the State Farm residence, southward to the mouth of the boring. That portion of the section from the Elk Lick coal downward was measured with hand level on the steep slope directly east of the well. The portion above the latter coal was measured with aneroid. The coal at 767.67 feet was taken out with a percussion core drill and was supposed to represent the Upper Freeport bed, but it evidently correlates with the Upper Kittanning vein:

Section at Sabraton, Morgan District.

Upper Carboniferous (792.25')	Thickness. Feet.	Total. Feet.	
Monongahela Series (45')			
Concealed from summit of hill ½ mile northeast of State farm	10	10	
Sandstone, massive, Upper Pittsburgh	25	35	
Coal, Pittsburgh (1195' B-A. T.)	10	45	45'
Conemaugh Series (599')			
Concealed	236.4	281.4	
Coal, Elk Lick, (3' 7") (955' L-A. T.)	3.6	285	240'
Fire clay shale	12	297	
Sandstone, limy and greenish shale	14	311	
Concealed	20	331	
Shale, gray limy	5	336	
Sandstone, massive, gray calcareous at top, Grafton	18	354	
Shale, dark green, fossil shells, Ames	6	360	
Concealed to top Bore Hole No. 5 (334)	5	365	
Sabraton Bore Hole No. 5 Record (334). (Elevation of top, 875' L-A. T.)			
Surface gravel	7	372	
Slate	1	373	
Limestone, (Lower Ames)	6	379	94'
Fire clay	36	415	
Shale, sandy	15	430	
Limestone	10	440	
Sandstone, (Saltsburg)	30	470	91'
Shale, variegated	43	513	
Sandstone, (Buffalo)	74	587	
Coal, (Brush Creek)	2	589	119'
Sandstone, (Mahoning)	55	644	55'
Allegheny Series (148.25')			
Coal 1' 6" / Shale 1 6 / Coal 2 0 (Upper Freeport coal)	5	649	
Fire clay	2	651	
Sandstone, white 34' / Sandstone, dark 41 (Upper Freeport)	75	726	
Coal, Lower Freeport	1	727	71'
Fire clay	13	740	
Shale, light sandy	14	754	
Shale, dark, sandy	9	763	
Slate, black, hard (4' 8")	4.67	767.67	
Coal with bony streaks 2' 0" / Slate 0 7 / Coal 0 2 (Upper Kittanning)	2.75	770.42	43.4'
Slate, limy (13' 10")	13.83	784.25	
Slate, black to bottom	8	792.25	

One-third mile southward the following section was obtained at the mouth of Aaron creek by combining a hand-leveled section measured on the steep point immediately to the southeast of the latter place with the log of the coal test Bore

Hole No. 3 (333) of the American Sheet & Tin Plate Co. The coal at 401.5 feet was taken out with a percussion core drill, and, at the time, was supposed to represent the Upper Freeport, but it evidently correlates with the Upper Kittanning:

Section at Mouth of Aaron Creek, Morgan District.

Upper Carboniferous (409')	Thickness. Feet.	Total. Feet.	
Conemaugh Series (285')			
Limestone, shaly, Ames, marine fossils	10	10	
Shale, gray	1	11	
Coal, Harlem	1	12	12
Fire clay shale	2	14	
Concealed to top Bore Hole No. 3 (333)	23	37	
Bore Hole No. 3 Record (333) (Elevation of top, 841' L-A. T.)			
Surface gravel	8	45	
Slate and shale	20	65	
Sandstone, gray	15	80	
Limestone	7	87	
Sandstone, (Saltsburg)	18	105	
Slate	20	125	
Limestone, (Pine Creek)	5	130	118'
Slate	2	132	
Shale, red	5	137	
Sandstone, (Buffalo)	74	211	
Slate, dark, Brush Creek	15	226	
Limestone	20	246	
Shale, sandy (Mahoning Sandstone horizon)	36	282	
Slate, Uffington	3	285	155'
Allegheny Series 124')			
Coal (½ slate), (Upper Freeport)	4	289	
Slate, dark	10	299	
Sandstone, (Upper Freeport)	33	332	
Coal and slate, (Middle Freeport)	3	335	50'
Slate, brown	25	360	
Coal, Lower Freeport	1	361	26'
Fire clay, dark	8	369	
Fire clay, hard	16	385	
Slate, brown, and shale, sandy	16.5	401.5	
Coal .....0' 9 " Bone .....0 2 Coal .....0 5½ Slate .....0 2½ Coal 0 2½	(1' 9½") Upper Kittanning)	1.8	403.3	42.3'
Slate, limy (1' 8")	1.7	405	
Limestone, Johnstown Cement Bed to bottom	4	409	5.7'

Another accurate section for this region in which the formations are correctly identified is that made in conjunction with the log of the Diamond Drill Hole No. 2 (335) of the American Sheet & Tin Plate Co., located 3500 feet northeast of the Pressed Prism Glass Factory. This section was pub-

lished on page 628 of Vol. II(A) of the State Survey reports. The errors in correlation of the coals in other borings of this company as given on page 629 of the latter report, have been corrected on preceding pages of this chapter.

The following section was obtained near Rock Forge on Deckers creek by combining a hand-leveled section with the log of the churn drill Bore Hole No. 4 (336) of the same company:

Section ½ Mile N. W. of Rock Forge, Morgan District.

Upper Carboniferous (446.3')	Thickness. Feet.	Total. Feet.	
Conemaugh Series (296')			
Concealed	20	20	
Limestone, silicious, shaly, many marine fossils, Lower Ames	1	21	
Shale, gray	0.5	21.5	
Coal, Harlem	1.5	23	23'
Fire clay shale	7	30	
Limestone, gray, brecciated, Ewing	1	31	
Concealed to top Bore Hole No. 4 (336)	13	44	21'
Bore Hole No. 4 Record (336) (Elevation of well mouth, 926' L-A. T.)			
Gravel	8	52	
Shale	8	60	
Limestone	2	62	
Shale	17	79	
Limestone and shale, mixed	30	109	
Sandstone, (Saltsburg)	40	149	105'
Slate or shale	25	174	
Sandstone, (Buffalo)	56	230	
Coal (local)	1	231	
Sandstone	5	236	
Slate, Brush Creek	8	244	
Coal and slate, (Brush Creek)	3	247	98'
Shale, sandy (Mahoning sandstone horizon)	49	296	49'
Allegheny Series (150.3')			
Coal, and slate (Upper Freeport)	4	300	
Fire clay	2	302	
Sandstone, (Upper Freeport)	43	345	
Slate	4	349	
Sandstone, dark	20	369	
Sandstone, white	12	381	
Coal, bony, (Lower Freeport)	1	382	82'
Slate, black (4")	0.3	382.3	
Fire clay	24	406.3	
Shale, dark, sandy	8	414.3	
Sandstone, dark	7	421.3	
Coal, (Upper Kittanning)	3	424.3	42.3'
Dark slate and shale	10	434.3	
Limestone, hard, (Johnstown Cement)	8	442.3	
Sandstone, brown, to bottom	4	446.3	22'

The following hand-leveled section was measured by Mr. Reger from the summit of a high knob, located 0.8 mile southwest of Sturgisson, northeastward to Deckers creek. It includes the Pottsville, Mauch Chunk and a portion of the Greenbrier Limestone:

Section at Sturgisson, Morgan District.

Upper Carboniferous (322')	Thickness. Feet.	Total. Feet.
Pottsville Series (322')		
Sandstone, gray, massive, capping knob Homewood	46	46
Concealed	55	101
Sandstone, massive, pebbly, quarry rock at Sturgisson sand plant, Upper Connoquenessing	65	166
Fire clay shale, brown and sandy	4	170
Shale, brown and sandy	2	172
Concealed	110	282
Sandstone, massive, Sharon	40	322
Coal streak (⅛")	0	322
Lower Carboniferous (498')		
Mauch Chunk (405')		
Concealed	377	699
Shale, red	38	737
Greenbrier Limestone		
Limestone, gray and hard, marine fossils. "Big Lime"	56	793
Concealed to Deckers Creek	27	820

The portion of the section included in the Mauch Chunk rocks was measured nearly due northward on the rapid dip of the strata; hence, the thickness of the latter series is shown about 100 feet greater than it should be.

CLINTON DISTRICT.—Clinton district occupies the southeastern portion of Monongalia county. The outcropping rocks within its area belong in the Monongahela, Conemaugh, Allegheny and Pottsville series.

The following hand-leveled section was measured down the steep eastern hillside of the Monongahela river, along the western border of Clinton district, from the summit of the knob located ½ mile northwest of Little Falls station. The section gives almost vertical measurements between important formations of the Conemaugh and Allegheny series. It also shows the true position of the Lower Connellsville sandstone which forms a prominent escarpment near the summit of the knob from which a grand view of the river is obtained:

Section ½ Mile Northeast of Little Falls, Clinton District.

Upper Carboniferous (571')	Thickness. Feet.	Total. Feet.	
Conemaugh Series (532.5')			
Sandstone, massive, pebbly, capping knob Connellsville	6	6	
Shale, yellowish, sandy	10	16	
Sandstone, greenish, medium grained, massive, forming cliff, Lower Connellsville	47	63	63'
Shale	5	68	
Concealed with reds	16	84	
Shale, red	26	110	
Concealed	10	120	
Shale, buff	15	135	
Slate, black	1	136	
Concealed and shale	36	172	
Fire clay and shale	4	176	
Sandstone, massive, Grafton	24	200	
Shale and concealed	19	219	
Shale, dark gray	5	224	
Shale, dark green, full of marine shells, Ames	16	240	
Concealed	5	245	
Coal blossom, Harlem (1151' L-A. T.)	1	246	181'
Fire clay and gray shale	15	261	
Concealed	36	297	
Fire clay shale	5	302	
Concealed	11	313	
Shale, yellow and brown, hard, ferriferous	4	317	
Concealed	11	328	
Fire clay shale	5	333	
Sandstone, shaly and sandy shells	21	354	
Sandstone, massive	9	363	
Shale, sandy	7	370	
Sandstone, massive, buff, Buffalo	67	437	191'
Shale, dark, Brush Creek, and concealed	16	453	
Shale, buff and brown	5	458	
Limestone, silicious, nodular, shaly and ferriferous	10.4	468.4	
Shale, buff, brown and sandy	15.6	484	
Concealed	21	505	
Sandstone, massive, Mahoning	27.5	532.5	95.5'
Allegheny Series (38.5')			
Coal 2' 1½"			
Slate, black 0 0½			
Coal 0 7½ } Upper Freeport coal	3.5	536	
Slate, dark gray 0 0½			
Coal 0 8			
Fire clay and concealed to Pool No. 12 level of Monongahela river	35	571	38.5'

The following hand-leveled section was measured near the central portion of Clinton district, southwestward nearly along the strike of the strata to the bed of Booths creek:

Section at Clinton Furnace, Clinton District.

Upper Carboniferous (345′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (150′)			
Concealed from top of knob	150	150	150′
Allegheny Series (195′)			
Coal, Upper Freeport	5	155	
Concealed and shale	50	205	
Coal 0′ 2″ / Slate, sandstone and shale 7 1 / **Coal** 0 9 — Lower Freeport coal (1140′ B-A. T., at base)	8	213	63′
Fire clay	4	217	
Sandstone, massive	5	222	
Shale	9	231	
Limestone, gray and hard, Lower Freeport.	2	233	
Shale, gray	4	237	
Sandstone, massive, Lower Freeport, upper division	11	248	
Coal, slaty (2″) (local)	0.2	248.2	35.2′
Shale, dark and sandy	9.8	258	
Concealed	11	269	
Shale, dark, sandy	5	274	
Coal 1′ 9″ / Slate, gray 0 1½ / **Coal** 0 9 — Upper Kittanning coal	2.6	276.6	28.4′
Fire clay and concealed	30	306.6	
Sandstone, massive, Lower Freeport, lower division	20	326.6	
Coal, Lower Kittanning	3	329.6	53′
Concealed to bed of Booths creek	15.4	345	15.4′

The 2 inches of slaty coal at 248 feet from the top appears to be a local streak, since it was not noted in numerous other sections for eastern Monongalia and Marion counties

The following aneroid section was measured along the southwest edge of Clinton district, from the summit of the knob just west of Triune, southwestward along the hill road to Whiteday creek:

Section at Triune, Clinton District.

Upper Carboniferous (381′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (168′)			
Sandstone, massive, coarse, brown and mottled, making cliffs and large boulders, Saltsburg	20	20	
Shale, brown and red	10	30	
Coal, blossom Bakerstown	..	30	30′
Concealed	15	45.	
Sandstone, massive, Buffalo	45	90	60′
Concealed along bench	15	105	

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, Mahoning	40	145	
Concealed and sandstone, massive	20	165	
Shale, gray	3	168	78′
Allegheny Series (213′)			
Coal at opening...2′ 0″ / Concealed by water .....1 0 } Upper Freeport coal	3	171	
Concealed	155	326	
Coal, blossom, heavy, Lower Kittanning	..	326	158′
Concealed to road fork, 1 mile S 15° W of Triune	20	346	
Concealed to Whiteday creek	35	381	55′

The section reaches probably to the base of the Allegheny measures. The interval—128 feet—from the blossom of the Bakerstown coal down to the Upper Freeport bed is much shorter than it should be on account of the rapid rise in the strata from the former southeastward to the point where the observation was taken on the latter. The same is true to some extent for the Upper Freeport-Lower Kittanning coal interval which should be about 175 feet.

The following aneroid section was measured by D. B. Reger along the southwestern edge of Clinton district westward from the summit of a high hill, located one-half mile northeast of Anita. The intervals in that portion included in the Conemaugh series are greater than should be, owing to the dip of the rocks in the direction the section was measured.

Section ½ Mile North of Anita, Clinton District.

Upper Carboniferous (489′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (306′)			
Shale .....0.7′ / Limestone, hard, marine fossils .....0.3 } Ames	1	1	
Coal, Harlem	1	2	
Shale, concealed and shale	132	134	
Sandstone and concealed	60	194	
Sandstone, concealed and sandstone	45	239	
Concealed and shale	67	306	306′
Allegheny Series (183′)			
Coal, medium hard...1′ 9″ / Slate, black.....0 2 / Coal, soft.....1 3 } Upper Freeport coal (3′ 2″)	3	309	
Concealed	60	369	
Slate, black, Lower Freeport coal horizon	0	369	63′
Sandstone, massive, brown, Lower Freeport	40	409	

	Thickness. Feet.	Total. Feet.	
Concealed	40	449	
Coal blossom, Lower Kittanning	0	449	80′
Shale with iron nuggets	15	464	
Sandstone, massive	10	474	
Concealed to Whiteday creek	15	489	40′

MARION COUNTY SECTIONS.

MANNINGTON DISTRICT.—Mannington district occupies the western portion of Marion county; hence, its outcropping rocks are confined entirely to the Dunkard and Monongahela series.

The following section was obtained near Glover Gap by combining the log of the A. M. Glover No. 4 well (354) with the thickness of the Dunkard rocks cropping above the well to the southwest. The well is owned by the Venture Oil Company, and Patrick Gallagher, Supt., is authority for well record:

Section 0.6 Mile Northwest of Glover Gap, Mannington District.

Upper Carboniferous (2380′)	Thickness. Feet.	Total. Feet.	
Dunkard Series (940′)			
Concealed from top knob 0.7 mile southwest of well	340	340	
A. M. Glover No. 4 Well Record (354)			
Unrecorded in well (gas in shale at 425′ depth)	440	780	
Coal, Washington	2	782	
Unrecorded (gas in shale at 518′ depth)	131	913	
Sandstone, Bluff, (Waynesburg)	25	938	
Unrecorded	2	940	
Monongahela Series (358′)			
Coal, Fairview (Waynesburg)	3	943	
Unrecorded	255	1198	
Coal, Mapletown (Sewickley)	5	1203	263′
Unrecorded	89	1292	
Coal, Pittsburgh	6	1298	95′
Conemaugh (536′)			
Unrecorded	108	1406	
Sandstone, Murphy? (Minshall) (Connellsville)	..	1406	
Unrecorded	289	1695	397′
Sandstone, Little Dunkard? (Saltsburg)	..	1695	
Unrecorded	80	1775	
Sandstone, Big Dunkard (Mahoning)	59	1834	139′
Allegheny Series (212′)			

	Thickness. Feet.	Total. Feet.	
Unrecorded	100	1934	
Sandstone, Lower Freeport	51	1985	
Unrecorded	61	2046	212′
Pottsville Series (334′)			
Gas? sand, Homewood and Upper Connoquenessing	137	2183	
Unrecorded	197	2380	334′
Lower Carboniferous (710′)			
Mauch Chunk Series (123′)			
Red rock	25	2405	
Unrecorded	20	2425	
Red rock	60	2485	
Limestone and unrecorded	18	2503	123′
Greenbrier Limestone (87′)			
Big Lime	87	2590	
Pocono Sandstones (500′)			
Sand, Big Injun (gas, 2272′; oil and water, 2342′)	158	2748	
Unrecorded	342	3090	500′
Devonian (251′)			
Catskill Sandstones (251′)			
Unrecorded	122	3212	
Sand, Fifty-foot	84	3296	
Unrecorded	29	3325	
Sand, Thirty-foot (oil, 2985′ and 2990′) to bottom	16	3341	251′

The following section was obtained in the east central portion of Mannington district, Marion county, by combining a hand-leveled section measured by D. B. Reger from the summit of the high hill immediately south of Mannington with part of the log of the Fleming Hamilton No. 1 well (541), published on pages 241-242 of Vol. I of the State Survey reports. The correlations in parentheses are by the writer:

Section at Mannington, Mannington District.

Upper Carboniferous (2032′)	Thickness.	Total.	
Dunkard Series (507′)	Feet.	Feet.	
Concealed from top of hill due south of Mannington	112	112	
Shale and concealed	25	137	
Sandstone, shaly	6	143	
Shale, brown,and concealed	25	168	
Sandstone, shaly	12	180	
Shale, silicious and variegated	28	208	
Shale, limy and variegated	23	231	
Sandstone, shaly, (Upper Marietta)	22	253	253′
Shale, red	17	270	
Shale, brown	12	282	
Shale, mostly red, (Creston)	24	306	

	Thickness. Feet.	Total. Feet.	
Concealed and shale	22	328	
Sandstone	6	334	
Shale	11	345	
Slate, dark	1	346	
Concealed	2	348	
Coal, slaty.....1′ 6″ ⎫ Shale, gray.....2 0 ⎬ Washington coal.... Coal .....1 6 ⎭	5	353	100′
Fire clay shale, gray....3′ ⎫ Shale, yellowish.....0 ⎭ Washington	12	365	
Sandstone, shaly	7	372	
Shale, green	6	378	
Concealed	5	383	
Sandstone, concealed, and sandstone, Mannington	23	406	
Shale, brown, to top Hamilton No. 1 well (541)	26	432	
Fleming Hamilton No. 1 Well Record (541) (Elevation, well mouth, 1055′ B-A. T.)			
Conductor	15	447	
Coal, Waynesburg "A"	1	448	95′
Slate	14	462	
Sandstone, (Waynesburg)	35	497	
Slate	10	507	59′
Monongahela Series (395′)			
Slate	15	522	
Sandstone, (Gilboy) (110′ of 10″ casing)	30	552	
Limestone	40	592	
Slate	35	627	
Lime and shale	142	769	
Slate	8	777	
Coal, Sewickley	12	789	
Slate, (water and gas at 360′)	35	824	
Limestone	48	872	
Slate, dark	19	891	
Coal, Pittsburgh	11	902	

The following section was obtained 3 miles southwest of Mannington by combining a hand-leveled section measured by D. B. Reger from the summit of a high knob northeastward along the hill road on the head of Whetstone run, with the log of the Michael Kennedy No. 1 well (516). The section is very interesting, in that three coals of the Dunkard series are noted; viz., Dunkard, Jollytown and Washington:

Whetstone Run Section, Mannington District.

Upper and Lower Carboniferous (2892′) Dunkard Series (650′)	Thickness. Feet.	Total. Feet.	
Shale and concealed from top of knob	21	21	
Sandstone, brown, flaggy, micaceous, fine grained, Burton	55	76	76′
Concealed and limy shale	17	93	

	Thickness. Feet.	Total. Feet.	
Sandstone	6	99	
Shale, brown	10	109	
Sandstone, shaly	11	120	
Shale, variegated	22	142	
Sandstone, shaly, Rush Run	40	182	
Shale, brown	15.7	197.7	
Coal (3"), Dunkard	0.3	198	122'
Fire clay shale	2	200	
Sandstone, brown, micaceous, hard, flaggy, fine grained, Jollytown	42	242	
Shale, dark	5	247	
Coal, slaty (9"), Jollytown	1	248	50'
Fire clay shale, gray	9	257	
Sandstone, shaly...14' / Shale ..... 4 / Sandstone, hard, brown, flaggy, micaceous .....31 } Hundred sandstone	49	306	58'
Shale, concealed, and shale	49	355	
Shale, variegated, mostly red (Creston Reds)	50	405	
Sandstone	6	411	
Shale variegated	25	436	
Sandstone, concealed and sandstone, Lower Marietta	30	466	
Concealed and shale	16	480	
Coal, Washington, to Michael Kennedy No. 1 well (516)	4	484	178'
Michael Kennedy No. 1 Well Record (516)			
Unrecorded	166	650	166'
Monongahela Series (395')			
Unrecorded	385	1035	
Coal, Pittsburgh	10	1045	
Conemaugh Series (559')			
Unrecorded	497	1542	
Sandstone, Dunkard (Mahoning) (oil and some water, 1983')	62	1604	559'
Allegheny, Pottsville and Mauch Chunk Series (698')			
Unrecorded	360	1964	
Sand, Salt (Upper Connoquenessing)	80	2044	
Unrecorded	258	2302	
Greenbrier Limestone (90')			
Big Lime	90	2392	90'
Pocono Sandstones (500')			
Sand, Big Injun (oil and some water, 1983')	108	2500	
Unrecorded	392	2892	500'
Devonian (356')			
Catskill Sandstones (356')			
Unrecorded	343	3235	
Sand, Gordon (1st oil pay, 2751': 2nd pay, 2764') to bottom	13	3248	356'

"8¼ inch casing, 1068': 6⅝ inch casing, 2020'; 5 inch casing, 2732'. The well was completed July 4, 1893 and abandoned July 27, 1906. Initial production over 1000 barrels of oil daily. Shot with 4 quarts of nitro-glycerine—5 inch shell—Feb. 26, 1895, top of shot, 2762': shot again with 8 quarts—5 inch shell—March 11, 1897 top of shot at 2762': and shot again on August 29, 1898, with 25 quarts—10 inch shell—top of shot at 2750'."

PAWPAW DISTRICT.—Pawpaw district, Marion county, lies east of Mannington district, west of the Monongahela river, and south of and adjoining Monongalia county. The outcropping rocks therein are confined entirely to the Dunkard, Monongahela and Conemaugh series of the Carboniferous measures.

In the northwestern portion of the district, the following section was obtained by combining an aneroid section measured from the summit of the high knob on the head of Laurel run southwestward along the hill road, approximately on the strike of the strata, with part of the log of the Brice Wallace No. 1 well (555), published on pages 238-239 of Vol. I of the State Survey reports and located on a branch of Rush run, 1 mile northeast of Fairview. In that portion of the section made up from the well record, the writer has inserted in parentheses corrections in correlation as given in Vol. I as well as names for other formations. It is quite evident that the Washington, Waynesburg "A" and Waynesburg coals were placed too low in the measures in the latter publication.

Section 1 Mile Northeast of Fairview, Pawpaw District.

Upper Carboniferous (2170')	Thickness.	Total.	
Dunkard Series (692')	Feet.	Feet.	
Concealed and sandstone from top of knob U. S. G. S. 1681' L-A. T.)	35	35	
Concealed	35	70	
Shale, buff, with thin sandstones	20	90	
Concealed	10	100	
Sandstone, shaly, (Burton)	25	125	
Concealed	70	195	195'
Fire clay shale (Fish Creek)	10	205	
Shale, buff	14	219	
Sandstone, nodular	1	220	
Shale, buff	5	225	
Sandstone, flaggy and shaly	10	235	
Shale, buff	9.7	244.7	
Coal (3"), Dunkard	0.3	245	50'
Fire clay and shale	2	247	
Sandstone, massive	7	254	
Fire clay shale	3	257	
Sandstone, shaly	8	265	
Concealed	10	275	
Shale, sandy, red and variegated	25	300	
Sandstone	5	305	
Concealed	20	325	
Sandstone, shaly	10	335	

	Thickness. Feet.	Total. Feet.	
Concealed	40	375	
Shale	5	380	
Sandstone, massive, Upper Marietta	25	405	160′
Concealed	30	435	
Sandstone	5	440	
Concealed	15	455	
Shale, gray	5	460	
Sandstone	5	465	
Concealed	43	508	
Shale	1	509	
Coal, slaty (10″), Washington "Rider"	1	510	
Concealed with shale	7	517	
Coal, Washington (Base 1160′ B-A. T.)	3	520	115′
Concealed to top Brice Wallace No. 1 well	35	555	
Brice Wallace No. 1 Well Record (555) (Elevation, 1025′ B-A. T.)			
Conductor (shutting off surface gravel and water)	12	567	
Slate, white	30	597	
Coal (Waynesburg "A")	4	601	81′
Slate and sandstone, Waynesburg	87	688	
Slate, (Cassville Plant Shale)	4	692	91′
Monongahela Series (397′)			
Coal, (Waynesburg)	7	699	
Slate	5	704	
Sandstone, white, sharp, (Gilboy)	40	744	
Coal, (Little Waynesburg)	6	750	58′
Limestone	39	789	
Slate and sandy shell	50	839	
Limestone	36	875	
Slate and limestone	60	935	
Sandstone, sharp and white (Upper Sewickley)	40	975	
Coal, Sewickley (water)	10	985	235′
Slate, soft	25	1010	
Limestone, hard (Sewickley)	35	1045	
Slate	30	1075	
Coal, Pittsburgh	14	1089	104′

The Wallace well was drilled on down to a depth of 1997 feet and proved a heavy gasser in the Big Injun sand.

The following aneroid section was measured in the southern point of Pawpaw district by D. B. Reger from the summit of a high knob, a mile and a half northwest of Rivesville, eastward along the hill road to the bed of Pawpaw creek at the mouth of Woods run:

Section Northwest of Rivesville, Pawpaw District.

Upper Carboniferous (575')	Thickness. Feet.	Total. Feet.	
Dunkard Series (405')			
Sandstone, capping knob	10	10	
Shale, brown	35	45	
Sandstone	10	55	
Concealed and shale, variegated	90	145	
Sandstone, brown	30	175	
Concealed and shale	85	260	
Sandstone, brown	15	275	
Shale, variegated	35	310	
Sandstone, shaly (Mannington)	28	338	
Coal, Waynesburg "A"	2	340	340'
Shale and concealed	29	369	
Sandstone, massive, brown and pebbly, Waynesburg	35	404	
Shale, gray, Cassville Plant Shale	1	405	65'
Monongahela Series (170')			
Coal, slaty..0' 6"			
Shale, gray.1 0			
Coal, blocky 1 6 } Waynesburg coal (4' 7").	5	410	
Slate, black.0 4			
Coal, good..1 3			
Concealed	20	430	
Sandstone, massive, medium grained, gray micaceous, Gilboy	25	455	
Concealed	9	464	
Coal, slaty, Little Waynesburg	1	465	60'
Limestone, hard, Waynesburg	10	475	
Concealed and shale	5	480	
Sandstone, massive, hard fine, green, Uniontown	10	490	
Concealed	25	515	50'
Sandstone, green flaggy and fine	20	535	
Limestone, concealed and limestone, Uniontown, to Pawpaw creek at mouth of Woods run	40	575	60'

The following hand-leveled section was measured by Mr. Reger in the extreme southern point of Pawpaw district from the summit of the high knob ½ mile northward from Dakota eastward to river level via the quarry in the Mannington sandstone ledge. This section is interesting in that it gives an accurate measurement between the Washington and Waynesburg coals on the eastern boundary of the Dunkard series.

Section 0.3 Mile North of Dakota, Pawpaw District.

Upper Carboniferous (110')	Thickness. Feet.	Total. Feet.
Dunkard Series (214.5')		
Concealed from top of knob	55	55
Coal, Washington	4	59

	Thickness. Feet.	Total. Feet.	
Concealed and brown shale	60	119	
Sandstone, gray, massive, quarried for ballast, Mannington	23	142	83′
Fire clay	0.5	142.5	
Concealed and sandstone	72	214.5	72.5′
Monongahela Series (195.5′)			
Coal ....0′ 8″ / Shale, gray..1 3 / Coal, good..0 9 / Coal, bony..0 8 / Coal, good..2 1 — Waynesburg coal (5′ 5″) (Base, 1038′ L-A. T.)	5.5	220	
Concealed	70	290	
Sandstone	3	293	
Shale and concealed	17	310	
Sandstone, green, shaly, Uniontown	26	336	
Slate, black, Uniontown coal horizon	2	338	118′
Limestone, shaly, yellow, Uniontown	9	347	
Shale, hard, green, limy	8	355	
Sandstone, massive, green	4	359	
Shale	3	362	
Sandstone, shaly	4	366	
Shale, green	6	372	
Limestone, Benwood, to pool No. 14 (848′ L-A. T.)	38	410	72′

LINCOLN DISTRICT.—Lincoln district occupies the southern central portion of Marion county; hence, the outcropping rocks therein are confined entirely to the Dunkard, Monongahela and Conemaugh series of the Carboniferous.

The following section was obtained along the eastern border of Lincoln district by combining a hand-leveled section measured by D. B. Reger with the log of the J. L. Davis diamond drill boring (654), located on Buffalo creek, 0.7 miles eastward from Farmington, the record of which was published on page 129-130 of Vol. II of the State Survey reports:

Farmington (Underwood) Section, Lincoln District.

Upper Carboniferous (712.4′)	Thickness. Feet.	Total. Feet.	
Dunkard Series (319′)			
Unrecorded from top knob, 0.6 mile North of boring	285	285	
Sandstone, massive, coarse, soft, buff and pebbly, Waynesburg	25	310	
Concealed	9	319	319′
Monongahela Series (393.4′)			
Coal ....0′ 6″ / Shale ....0 2 / Coal ....1 0 / Fire clay....1 4 / Coal ....3 0 — Waynesburg coal (See Vol. II, p. 129)	6	325	

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, brown and steel gray, cross-bedded, Gilboy	25	350	
Concealed	50	400	
Sandstone, shaly, Uniontown	17	417	
Shale, brown, Annabelle	10	427	
Slate, black, Uniontown coal horizon	0.5	427.5	108.5'
Limestone, hard..2' 6" / Limestone, shaly..4 0 } Uniontown Limestone	6.5	434	
Shale	15	449	
Sandstone, massive	3	452	
Shale, gray	2	454	
Limestone, silicious	2	456	
Shale, brown to top of J. L. Davis diamond drill boring (654)	19	475	47.5
J. L. Davis Diamond Drill Boring Record (654)			
(Elevation of top of hole, 923' L-A. T.)			
Sand and clay surface (13' 2")	13.1	488.16	
Limestone, yellow and gray ..... 9' 6" / Shaly limestone and green shale.....30 0 / Limestone, gray..... 5 0 / Shale, green..... 5 0 / Limestone, gray.....14 0 / Limy shale ..... 6 0 } Benwood Limestone	69.5	557.66	
Sandstone, micaceous, with streaks of sandy shale, Upper Sewickley	31.1	588.67	
Black slate	1	589.67	
Coal .....3' 0. / Slate .....0 2 / Coal .....3 2 } Sewickley coal (6' 4")	6.33	596	121'
Shale, soft and gray	6.5	602.5	
Limy shale	5.5	608	
Sandy shale	2.5	610.5	
Limy shale, gray, getting sandy at base	18	628.5	
Limestone, gray .....20' 0" / Shale, green.. 3 6 / Limestone, gray ..... 3 0 } Sewickley Limestone.	26.6	655.1	
Limy shale and impure limestone (25' 8")	25.7	680.8	
Sandstone, micaceous, interstratified with dark sandy shale, Upper Pittsburgh	16.4	697.2	
Shale, sandy (6' 1")	6.1	703.3	
Coal "roof".....1' 5" / Over clay.....0 7½ / Bone coal.....0 2½ / Coal, good.....2 8 / Coal with thin slates.0 4 / Coal, good.....3 10 } Pittsburgh coal (9' 1")	9.1	712.4	

That portion of the above section from the top of the Waynesburg sandstone down to the top of the bore hole was measured by Mr. Reger with hand-level, and the results show

the thickness of the Monongahela series to be 35 feet less than that given for the Farmington section on page 130 of Vol. II of the State Survey reports. This discrepancy is no doubt due to the fact that that portion of the latter section above the well mouth was measured with aneroid.

The following section was obtained along the northwestern border of Lincoln district by combining measurements made by Mr. Reger with the log of the Rezin Amos No. 1 well (599), located on the east bank of Mods run, one mile and three-tenths northward from Downs Station (Broomfield P. O). The well was completed July 18, 1890, and the log furnished by J. Garber, Contractor:

Section North of Downs, Lincoln District.

Upper Carboniferous (1873')	Thickness. Feet.	Total. Feet.	
Dunkard Series (410')			
Unrecorded from summit of knob ½ mile northeast of well (599)	250	250	
Coal, Washington, old opening, thickness concealed	..	250	250'
Concealed (hand-level measurement) to Amos No. 1 well (599)	50	300	
Rezin Amos No. 1 Well Record (599) (Elevation top of hole, 1117' L-A. T.)			
Conductor	10	310	
Slate	6	316	
Lime	8	324	
Slate	8	332	
Coal, (Waynesburg "A")	2	334	84'
Slate	11	345	
Sandstone, hard, (Waynesburg)	55	400	
Slate, (Cassville Plant Shale)	10	410	76'
Monongahela Series (407')			
Coal, Waynesburg	4	414	
Sandstone, hard, (Gilboy)	31	445	
Lime	3	448	
Slate	5	453	
Lime	5	458	
Slate	6	464	
Lime, white	15	479	
Slate	11	490	
Lime	10	500	
Slate, black (Uniontown coal horizon belongs near base)	15	515	105'
Lime	10	525	
Slate	4	529	
Lime	36	565	
Sandstone, (Arnoldsburg)	7	572	57'
Lime, (Benwood)	78	650	
Slate	10	660	

	Thickness. Feet.	Total. Feet.	
Sand, (Upper Sewickley)	20	680	
Coal, Mapletown (Sewickley)	7	687	115′
Lime .....53′			
Slate .....10 } Sewickley Limestone..	88	775	
Lime 25			
Slate, white	10	785	
Slate, black	25	810	
Coal, Pittsburgh	7	817	130′
Conemaugh Series (593′)			
Slate	28	845	
Lime	40	885	
Sand, hard, (Connellsville)	25	910	
Lime	35	945	
Sand, (Lower Connellsville)	10	955	
Slate	35	990	
Lime	10	1000	
Slate, red	50	1050	
Slate	30	1080	
Lime, (Ames)	10	1090	273′
Slate	25	1115	
Slate, red (Pittsburgh Reds)	20	1135	
Lime	22	1157	
Sand, Saltsburg	30	1187	97′
Slate	29	1216	
Sand, (Buffalo)	17	1233	
Slate	67	1300	
Lime	10	1310	
Sand, Mahoning	100	1410	223′
Allegheny Series (202′)			
Slate	30	1440	
Slate and shale	75	1515	
Sandstone, (Lower Freeport)	15	1530	
Shale	24	1554	
Slate black	58	1612	202′
Pottsville Series (261′)			
Sandstone, Homewood	60	1672	
Shale	84	1756	
Sandstone, (Upper and Lower Connoquenessing)	117	1873	261′
Lower Carboniferous (386′)			
Mauch Chunk Series (177′)			
Shale	127	2000	
Lime	20	2020	
Slate, red	30	2050	177′
Greenbrier Limestone (105′)			
Lime (Big Lime)	105	2155	105′
Pocono Sandstones (104′)			
Sandstone .....56′			
Lime 10			
Sand, hard (oil, 1932′)....24			
Sand, soft ..... 7 } Big Injun....	104	2259	104′
Sand, hard, (oil, increased)			
to bottom..... 7			

In the southern edge of Lincoln district D. B. Reger measured the following hand-leveled section southward from the summit of a high hill to West Fork river at the mouth of Tevebaugh creek. Owing to the dip of the strata in the opposite direction to that in which the section was measured, the intervals are slightly less than they should be:

Section ¼ Mile West of Worthington, Lincoln District.

Upper Carboniferous (526')	Thickness. Feet.	Total Feet.	
Dunkard Series (204')			
Concealed from top of hill to well (648)....	28	28	
Concealed	130	158	
Sandstone, massive, coarse and pebbly, Waynesburg	44	202	
Shale, gray, Cassville.....	2	204	204'
Monongahela Series (322')			
Coal, Waynesburg	7	211	
Concealed	26	237	
Sandstone, shaly, Gilboy.....	4	241	
Concealed	23	264	
Sandstone, shaly.....	10	274	
Shale, gray.....	12	286	
Coal, Uniontown, thickness concealed.....	0	286	82'
Limestone, hard, Uniontown.....	4	290	
Concealed	39	329	
Sandstone	6	335	
Concealed and limestone.....	20	355	
Concealed	15	370	
Coal, Lower Uniontown.....	1	371	85'
Limestone, silicious, Benwood.....	43	414	
Shale, silicious gray.....	21	435	
Sandstone, massive	2	437	
Shale, gray.....	2	439	
Coal, Sewickley (Base, 949' L-A. T.).....	6	445	74'
Shale, gray and limy.....	36	481	
Limestone, hard Sewickley.....	10	491	
Shale, gray and limy.....	5	496	
Sandstone, shaly.....	2	498	
Shale, gray	6	504	
Concealed to river, mouth of Tevebaugh creek	22	526	81'

The section lacks 15 to 50 feet of reaching to the base of the Monongahela series; hence, the Pittsburgh coal lies about 40 feet below the river at the mouth of Tevebaugh creek.

North 30° east, 2.4 miles from Worthington the Fairmont Coal (now Consolidation Coal) Company put down their diamond drill **Bore Hole No. 2 (660) on the J. L. Jones** tract on Little Mill Fall run, the detailed record of which is published

on pages 676-677 of Vol. II (A) of the State Survey reports. This is a very important record in that it gives an accurate measurement of the thickness—419′ 10″—of the Monongahela series where the latter appears to have reached its maximum development. Most of the increase seems to have taken place in the interval separating the Sewickley and Pittsburgh coals.

FAIRMONT DISTRICT.—Fairmont district occupies that portion of Marion county lying eastward from Lincoln district to the Monongahela and West Fork rivers; hence, the outcropping rocks therein belong in the Dunkard, Monongahela and Conemaugh series.

The following section was obtained in the southwest edge of the district by combining a hand-leveled section measured along the hill road to the Nancy Martin Diamond Drill Boring No. 6 (659) of the Consolidation Coal Co., located on Mill Fall run, one mile and two-fifths northwest of Monongah. In the hand-leveled portion of the section, the intervals and thicknesses of formations are slightly less than they should be on account of the measurements being taken in descending order along the rise of the strata; hence, a corresponding reduction in the thickness of the Monongahela series:

Section 1.4 Miles Northwest of Monongah, Fairmont District.

Upper Carboniferous (573.9′)	Thickness. Ft.	In.	Total. Ft.	In.	
Dunkard Series (191.5′)					
Shales capping hill 0.4 mile northeast of boring (659)	8	0	8	0	
Coal, Washington (1338′ L-A. T.)	3	0	11	0	11′
Concealed	20	0	31	0	
Fire clay shale	5	0	36	0	
Shale, brown and red	21	0	57	0	
Concealed and shale	21	0	78	0	
Sandstone, massive, Mannington	21	0	99	0	
Concealed	10	0	109	0	98′
Fire clay shale	10	0	119	0	
Shale	4	0	123	0	
Sandstone, massive, coarse brown and pebbly, Waynesburg	68	0	191	0	
Shale, gray	0	6	191	6	82.5′
Monongahela Series (381.2′)					
Coal ....0′ 9″ Slate ...0 0½ **Coal** ....0 11 Shale. gray ..1 2½ **Coal** ....3 6 — **Waynesburg coal**	6	5	197	11	

	Thickness. Feet.	In.	Total. Feet.	In.	
Concealed	9	1	207	0	
Sandstone, shaly top, massive at bottom, Gilboy	30	0	237	0	
Concealed	5	0	242	0	
Shale, sandy	20	0	262	0	
Coal .....0′ 4″ Shale, gray....0 1 Coal .....0 7 — Uniontown coal	1	0	263	0	715′
Fire clay and shale	13	0	276	0	
Concealed	8	0	284	0	
Sandstone, massive	26	0	310	0	
Concealed	5	0	315	0	
Limestone, yellowish	5	0	320	0	
Concealed to Bore Hole No. 6 (659)	26	0	346	0	83′
Nancy Martin Boring No. 6 Record (659). (Elevation, 998′ L-A. T.)					
Surface	8	0	354	0	
Lime and fire clay	28	0	382	0	
Shale, light	4	0	386	0	
Lime .....8′ 10″ Shale, light ....4 2 Lime .....9 3 Sand .....4 2 Shale, gray ... 4 8 Fire clay and lime ...10 1 — Benwood Limestone	41	2	427	2	
Sand Upper Sewickley	3	2	430	4	
Slate, dark	11	0	441	4	
Coal .....2′ 2 ″ Slate, black..0 0½ Coal .....4 2½ — Sewickley coal	6	5	447	9	101.7′
Fire clay	6	8	454	5	
Sand, Lower Sewickley	15	3	469	8	
Shale, sandy	6	5	476	1	
Fire clay	1	8	477	9	
Sand	10	7	488	4	
Fire clay	1	5	489	9	
Lime, Sewickley	14	9	504	6	
Shale, light	7	5	511	11	
Fire clay	15	9	527	8	
Shale sandy	4	0	531	8	
Fire clay	5	7	537	3	
Shale, dark	6	0	543	3	
Shale, sandy	5	0	548	3	
Slate, dark	10	1	558	4	
Sand	2	10	561	2	
Slate, black	1	10	563	0	
Coal .....0′ 5 ″ Slate ....0 9 Coal .....3 8 Bone .....0 1 Coal .....0 4 Bone .....0 0½ Coal .....4 5 — Pittsburgh Coal (Elevation of base, 771.29 L-A. T.)	9	8½	572	8½	124.9′

	Thickness. Feet.	In.	Total. Feet.	In.	
Conemaugh Series (1′ 2½″)					
Slate	0	9	573	5½	
Fire clay to bottom	0	5½	573	11	1.2

The following hand-leveled section was measured southward to Buffalo creek by D. B. Reger from the summit of the high knob located 0.8 mile north 60° east from Barrackville station. It shows the relative position of the cropping rocks along the eastern border of Fairmont district:

Section 0.7 Mile East of Barrackville, Fairmont District.

Upper Carboniferous (434′)	Thickness. Feet.	Total. Feet.	
Dunkard Series (254′)			
Sandstone, capping knob, 0.8 mile north 60° east of Barrackville Station	10	10	
Concealed and shale	68	78	
Coal, Washington (about 4 feet)	4	82	82′
Shale and concealed	55	137	
Sandstone, massive, Mannington	33	170	
Shale and concealed	17	187	
Coal, Waynesburg "A" (thickness concealed)	0	187	105′
Concealed	12	199	
Sandstone	5	204	
Shale and concealed	17	221	
Limestone, hard	4	225	
Sandstone, massive, Waynesburg	18	243	
Concealed	11	254	67′
Monongahela Series (180′)			
Coal, Waynesburg (about 4 feet)	4	258	
Concealed	15	273	
Sandstone, Gilboy	9	282	
Concealed	11	293	
Limestone, hard, Waynesburg	7	300	
Concealed	12	312	
Sandstone, shaly, concealed and sandstone, Uniontown	33	345	
Shale, gray. Annabelle	12	357	
Slate, black, thickness concealed (Uniontown coal horizon)	0	357	103′
Shale and limestone 5′ / Sandstone, limy 2 / Limestone and shale 4 — **Uniontown Limestone.**	11	368	
Sandstone	4	372	
Concealed and shale	14	386	
Sandstone, hard, green, massive, fine grained, Arnoldsburg?	14	400	43′
Shale, limestone and shale	12	412	
Limestone, Benwood, to Buffalo creek	22	434	34′

The following section was obtained near the central portion of Fairmont district, on Ice's run, one mile northwest of Fairmont, by combining a hand-leveled section measured by D. B. Reger from the summit of a high knob westward, with the log of the Shore Diamond Drill Boring No. 7 (672). The record of the latter was kindly furnished by the Consolidation Coal Co. Eight coal beds are noted in the section:

Ice's Run—Fairmont Section, Fairmont District.

Upper Carboniferous (602.4')	Thickness. Ft.	In.	Total. Ft.	In	
Dunkard Series (207')					
Concealed from top of knob located 0.4 mile eastward from boring (672)	46	0	46	0	
Coal, Washington (about 2 feet) (1253' L-A. T)	2	0	48	0	48'
Shale, yellow	32	0	80	0	
Concealed	100	0	180	0	
Sandstone, Waynesburg	24	0	204	0	
Shale, fossil plants, Cassville	3	0	207	0	159'
Monongahela Series (393.8')					
Coal, hard....0' 7" Shale, gray....1 5 Coal .....0 8 Shale, gray....0 4 Coal .....0 10 — (3' 10") Waynesburg Coal.... (Elevation of base, 1090' L-A. T.)	4	0	211	0	
Concealed	40	0	251	0	
Coal, streak, Little Waynesburg	0	0	251	0	
Concealed and shale	11	0	262	0	
Sandstone, green, shaly, Uniontown	22	0	284	0	
Concealed	10	0	294	0	
Coal, Uniontown	1	0	295	0	88'
Shale and concealed to Shore Bore Hole No. 7 (672)	22	0	317	0	
Shore Bore Hole No. 7 Record (672) (Elevation of top, 984.24' L-A. T.)					
Surface	9	0	326	0	
Lime, sandy	20	0	346	0	
Fire clay	9	6	355	6	
Shale, light	6	0	361	6	
Fire clay	2	8	364	2	
Shale, light	9	10	374	0	
Shale, red	3	0	377	0	
Lime .... 2' 0" Fire clay. 4 0 Lime ....35 0 Fire clay. 3 2 Lime with shale streaks 32 11 — Benwood Limestone	77	1	454	1	
Shale, sandy	8	5	462	6	
Slate, dark	4	6	467	0	

		Thickness. Feet.	In.	Total. Feet.	In.	
Coal .....1′ 9″						
Lime 0 3						
Coal 0 2						
Binder 0 1						
Coal 0 4	Sewickley coal..	5	5	472	5	177.4′
Slate binder...0 2	(Elevation of					
Coal 1 8	base, 828.82′					
Slate binder...0 3	L-A. T.)					
Coal 0 3						
Slate binder...0 3						
Coal 0 3						
Slate, dark.....		1	8	474	1	
Fire clay.....		2	0	476	1	
Slate, dark.....		7	6	483	7	
Coal, Lower Sewickley.....		0	2	483	9	11.3′
Fire clay.....		4	8	488	5	
Shale, sandy.....		7	0	495	5	
Fire clay.....		7	2	502	7	
Shale, dark.....		15	0	517	7	
Coal, Redstone.....		0	11	518	6	34.7′
Fire clay, slaty.....		5	0	523	6	
Lime, Redstone.....		23	5	546	11	
Sandy fire clay.....10′ 5″	Upper					
Sandy fire clay	Pittsburgh					
with lime streaks.18 0	Sand-					
Sand 2 4	stone	30	9	577	8	
Slate, dark.....		13	2	590	10	
Coal .....0′ 9″						
Slate,						
black...0 3						
Coal 3 9	Pittsburg coal....	10	0	600	10	82.3′
Binder ...0 0½	(Elevation of base,					
Coal 0 6½	700.41′L-A. T.)					
Binder ...0 1						
Coal 4 7						
Conemaugh Series (1′ 7″)						
Fire clay to bottom of hole.....		1	7	602	5	

The composition of the Sewickley coal, as reported by the company, is given on a subsequent page under the discussion of the bed.

GRANT DISTRICT.—Grant district, Marion county, occupies all that portion of the latter area lying south of the West Fork river and southwest of the Tygart Valley river; hence, the outcropping rocks in this district are confined to the Dunkard, Monongahela, Conemaugh and Allegheny series. The following hand-leveled section was measured by D. B. Reger along the northwestern border of the district westward from the summit of what is known as the "Watson Knob" to Booths creek at the Wm. Watson No. 1 well (674), located

0.5 mile southeast of Monongah. Owing to a dip of 50 to 70 feet in the measures in the opposite direction from that in which the section was measured, the thicknesses of formations and intervals are slightly greater than they should be:

Section ½ Mile Southeast of Monongah, Grant District.

Upper Carboniferous (456')	Thickness. Feet.	Total. Feet.	
Dunkard Series (25')			
Sandstone, coarse, brown, soft and pebbly, "Watson Knob" in lone column, Waynesburg	25	25	25'
Monongahela Series (431')			
Slate, black, coaly streak, Waynesburg	0	25	
Concealed	116	141	
Sandstone, green, flaggy, fine grained, Uniontown	41.7	182.7	
Slate, black (3")	0.3	183	158'
Concealed	51	234	
Limestone, with shale layers, Benwood	71	305	
Concealed	19.5	324.5	
Coal, Sewickley	3.5	328	145'
Concealed	4	332	
Sandstone	7	339	
Shale and concealed	16	355	
Sandstone, limy	12	367	
Shale, gray	1.7	368.7	
Slate, black (3")	0.3	369	
Limestone, hard	11	380	
Shale, silicious	16.8	396.8	
Black slate, Redstone coal horizon	0.2	397	69'
Shale and concealed	20	417	
Limestone, hard, Redstone	12	429	
Sandstone, gray, Upper Pittsburgh	10	439	
Shale, gray to well mouth of Wm. Watson No. 1 (674)	3	442	
Shale, gray	6	448	
Coal, Pittsburgh, to bed of Booth's creek	8	456	57'

For the rock succession in the southern point of Grant district, the reader is referred to the Boothsville section, published on pages 109-110 of the Doddridge-Harrison Report of the State Survey.

WINFIELD DISTRICT.—Winfield district occupies the north portion of that part of Marion county lying on the east side of the Monongahela river; hence, its outcropping rocks are confined to the Monongahela, Conemaugh, Allegheny, and Pottsville series.

The following section was obtained along the north-

western border of Winfield district from the log of the A. Boutlou No. 1 well (666), located on the south side of the Monongahela river one mile westward from Montana Mines. This well was drilled during 1912, and the record kindly furnished the Survey by Anthony Bowen of Fairmont:

Montana Mines Section, Winfield District.

(A. Boutlou No. 1 Well Record (666).

Upper Carboniferous (1340')	Thickness. Feet.	Total. Feet.	
Monongahela Series (243')			
Unrecorded	235	235	
Pittsburgh coal	8	243	243'
Conemaugh Series (607')			
Unrecorded	242	485	
Sand, (Grafton)	25	510	
Unrecorded	126	636	
Sand, Little Dunkard? (Saltsburg)	10	646	
Unrecorded	139	785	
Sand, Big Dunkard..25' / Unrecorded .....25 / Sand .....15 (Mahoning)	65	850	204'
Allegheny Series (230')			
Unrecorded	100	950	
Gas sand (Lower Freeport)	70	1020	
Coal, (Lower Kittanning)	5	1025	175'
Unrecorded	55	1080	55'
Pottsville Series (260')			
Sand, First Salt? (I Cow Run) (Homewood)	30	1110	
Unrecorded	10	1120	
Sand, Second Salt? (Upper Connoquenessing)	30	1150	
Unrecorded	45	1195	
Sand, bottom streak (little water) (Lower Connoquenessing)	50	1245	
Unrecorded	10	1255	
Sand, (Sharon)	85	1340	260'
Lower Carboniferous (683')			
Mauch Chunk Series (250')			
Unrecorded	50	1390	
Red rock	60	1450	
Limestone	20	1470	
Red rock	30	1500	
Slate	40	1540	
Limestone	15	1555	
Red rock	10	1565	
Limestone	10	1575	
Pencil cave	15	1590	250'
Greenbrier Limestone (68')			
Big Lime	64	1654	
Red rock (not real red)	4	1658	68'
Pocono Sandstones (365')			
Big Injun sand	107	1765	
Slate	78	1843	

	Thickness. Feet.	Total. Feet.	
Squaw sand (fairly good)	57	1900	
Slate and shale	65	1965	
Berea Grit sand (hard, limy)	35	2000	
Slate	8	2008	
Sand, hard (15 feet good sand)	15	2023	
Devonian (1484')			
Catskill Sandstones (800')			
Slate and shale (hard, limy)	112	2135	
Fifty-foot sand (very hard, show of gas at 2180')	75	2210	
Slate and shales, hard, sandy	80	2290	
Red rock and shells	15	2305	
Sand, Gordon Stray	28	2333	
Red rock	27	2360	
Gordon sand	17	2377	
Red rock (formation shelly. At Fourth sand horizon found red sandy shales, hard)	223	2600	577'
Fifth sand	17	2617	
Slate	37	2654	
Bayard sand	52	2706	
Slate	17	2723	223'
Chemung Series (684')			
Slate, shells and limestones, sometimes gritty, but no clear indication of sand	684	3507	684'

10 inch casing 284'; 8¼ inch casing, 1248'; 6½ inch casing, 1697½'.

The rock succession along the eastern border of Winfield district is well illustrated by the log of the Brent S. Jones No. 1 well (682A), published on pages 151-152 of Vol. I(A) of the State Survey reports. This well is located on the west bank of Whiteday creek, 1.5 miles due south of Whiteday (Smithtown). The Harlem coal crops in the hill to the southwest, 285 feet by aneroid above the well, and the Upper Freeport coal about 15 feet above the top of the hole; hence, the correlations of the coals as published in the reference above given should be corrected accordingly.

UNION DISTRICT.—Union district, Marion county, occupies the southern portion of that part of the latter area east of the Monongahela and Tygart Valley rivers; hence, the cropping rocks therein are confined entirely to the Monongahela, Conemaugh, Allegheny, and Pottsville series.

On page 636 of Vol. II(A) of the State Survey reports, I. C. White gives an interesting partial section of the Conemaugh measures for the western border of the district. This section was measured on the river hill, one-half mile below Colfax.

The following hand-leveled section was measured along the southern border of the district from the summit of a knob, located 0.6 mile northeast of Powell station, southeastward to Tygart Valley river. That portion above the base of the Allegheny series was measured on a very steep slope on the rise of the strata; hence, the thicknesses of formations and intervals, and of the latter measures are slightly less than they should be. The figures for the Pottsville are very close the facts, since they represent almost vertical measurements, and were determined from exposures along the B. & O. railroad grade about one-half mile northwest of Hammond. Two well known fossiliferous (marine) Conemaugh formations are present; viz., the **Pine Creek limestone** and the **Brush Creek shale,** and these help very materially to identify positively the base of the latter series. The section differs somewhat from that of I. C. White, published on pages 571-572 of Vol. II(A) of the State Survey reports. The discrepancies are probably caused largely by the more accurate measurement with hand-level than with aneroid, and by observations on different exposures of the same formations:

Section ½ Mile Northeast of Powell, Union District.

Upper Carboniferous:		Thickness. Feet.	Total Feet.	
Conemaugh Series (177′)				
Concealed with yellowish sandy shale from top of knob		47	47	
Limestone, silicious, many marine fossils, Pine Creek		2	49	49′
Sandstone, shaly, green, forms cliff....16′				
Shale, gray and sandy... 5	**Buffalo Sandstone**	56	105	
Sandstone, shaly, and sandy shale....35				
Concealed and dark shale		5	110	
Shale, dark, full of marine fossils ....0′ 2″	**Brush Creek**			
Slate, black (6″)....0 10	**Shale**	1	111	
Coal, Brush Creek, 8″ to		1	112	63′
Fire clay and gray shale		5	117	
Sandstone, massive, great cliff, Mahoning		60	177	65′
Allegheny Series (226′)				
Coal, blossom, with black slate, Upper Freeport coal horizon		1	178	
Fire clay and concealed		8	186	

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, coarse and pebbly .....34.7′ | Upper Coal (4″), local..... 0.3 } Freeport Sandstone, massive, coarse pebbly .....15 } Sandstone	50	236	
Concealed with coal blossom at base, Lower Freeport coal.....	5	241	
Concealed	4	245	
Sandstone, green, shaly, Lower Freeport....	15	260	
Concealed	10	270	
Sandstone, green, flaggy and shaly, Lower Freeport	25	295	
Coal, Upper Kittanning.....	3	298	121
Fire clay.....	5	303	
Sandstone, massive, or micaceous, Lower Freeport	25	328	
Concealed	7	335	
Shale, silicious, with thin sandstone.....	10	345	
Slate, dark gray.....	10	355	
Cannel slate...0′ 6″ Coal bony.....0 6 Coal, slaty.....2 4 } Lower Kittanning coal Coal, bony.....0 8 Coal, soft.....1 0	5	360	62′
Fire clay and concealed.....	26	386	
Sandstone, flaggy.....	3	389	
Shale, sandy.....	3	392	
Coal .....1′ 1″ Shale, gray....0 1 } (3′ 2″) Clarion..... Coal 2 0	3	395	
Slate, black.....	2	397	
Fire clay and concealed.....	6	403	43′
Pottsville Series (199′)			
Sandstone, massive, pebbly, white, Homewood	36	439	
Fire clay.....	2	441	
Coal, Tionesta.....	2	443	40′
Fire clay, medium hard.....	6	449	
Shale, sandy, laminated with iron ore nuggets.	31	480	
Coal, soft (8″).....	1	481	
Fire clay and shale.....	15	496	
Coal bony (2″).....	0	496	
Fire clay, flinty, Hammond, 4 feet to.....	1	497	
Shale, black, 4 feet to.....	0	497	
Coal, bony...2′ 0″ Slate, black..0 2 Coal, soft.....2 3 } (5′ 5″) Upper Mercer Slate, black..0 2 Coal, blocky..0 10	5.4	502.4	59.4′
Fire clay, medium hard.....	3	505.4	
Sandstone, flaggy and dark.....	4	509.4	
Shale, sandy and hard.....	5	514.4	
Shale, sandy and soft.....	5	519.4	
Limestone, ferriferous, hard, Lower Mercer (6″).....	0.5	519.9	
Shale, gray.....	1	520.9	

	Thickness. Feet.	Total. Feet.	
Slate, black...2′ 0″ / Coal .....0 2 } Lower Mercer coal...	2.1	523	
Fire clay, hard, good.....	4	527	
Shale	5	532	29.6′
Sandstone, massive, white, conglomeratic, pebbly, making falls in river at Valley Falls, and penetrated by water well there 70′ without reaching bottom of sandstone, Upper Connoquenessing.....	70	602	70′

The section also shows that the flint fire clay, mined at Hammond by the Hammond Fire Brick Company, belongs immediately above the Upper Mercer coal.

TAYLOR COUNTY SECTIONS.

BOOTHS CREEK DISTRICT.—Booths Creek district occupies the northwestern corner of Taylor county; hence, the outcropping rocks therein belong in the Monongahela, Conemaugh, Allegheny and Pottsville series. On page 109 of the Doddridge-Harrison report of the State Survey the writer gave a section for the Boothsville region of this district.

The following aneroid section was measured by D. B. Reger in the southwestern corner of Booths Creek district from the summit of Patton Knob, located 0.5 mile southwest of Meadland, northwestward along the hill road:

Section ½ Mile West of Meadland, Booths Creek District

Upper Carboniferous (495′)	Thickness. Feet.	Total. Feet.	
Monongahela Series (100′)			
Sandstone, capping "Patton Knob" (See Map II).....	5	5	
Concealed	20	25	
Limestone, good, Sewickley.....	5	30	
Concealed	40	70	
Sandstone, shaly.....	5	75	
Concealed	18	93	
Coal, Pittsburgh (Elevation of base, 1571′ L-A. T.).....	7	100	100′
Conemaugh Series (395′)			
Concealed	14	114	
Coal, Little Pittsburgh.....	1	115	
Concealed, sandstone and concealed.....	15	130	
Coal streak.....	0	130	
Shale and concealed.....	25	155	
Slate	1	156	
Shale, variegated.....	19	175	
Limestone, shaly.....	5	180	

	Thickness. Feet.	Total. Feet.	
Shale, sandy	15	195	
Sandstone	5	200	
Shale and concealed	20	220	
Coal, streak, Little Clarksburg	0	220	120′
Concealed and shale	25	245	
Limestone, Clarksburg	5	250	
Concealed and red shale	55	305	
Shale, brown	15	320	
Coal streak, Elk Lick?	0	320	
Concealed	40	360	
Shale, dark green, marine, fossils, Ames	10	370	150′
Concealed and red shale, "Pittsburgh Reds"	45	415	
Sandstone, shaly	35	450	
Concealed with shale to foot of hill	45	495	125′

FLEMINGTON DISTRICT.—Flemington district occupies the southwestern portion of Taylor county; hence, the outcropping rocks therein belong in the Monongahela and Conemaugh series exclusively. On the southwestern border of the district, D. B. Reger measured the following hand-leveled section from the summit of the high knob, located 0.6 mile southwest of Tyrconnell Mines, northeastward to railroad grade at the latter place. The section is important, in that it gives an accurate measurement of the interval between the Pittsburgh and Harlem coals:

Tyrconnell Mines Section, Flemington District.

Upper Carboniferous (615′)	Thickness. Feet.	Total. Feet.	
Monongahela Series (274′)			
Shale, sandy, capping knob	27	27	
Sandstone, hard, green, flaggy, fine grained (Arnoldsburg)	33	60	60
Concealed	8	68	
Limestone	1	69	
Concealed	60	129	
Sandstone, shaly	10	139	
Shale, brown	3	142	
Limestone, good (Benwood)	6	148	
Shale, limy	17	165	
Shale, brown	5	170	
Sandstone fine, green, flaggy	8	178	
Concealed	9	187	
Sandstone, (Lower Sewickley)	24	211	
Concealed	60	271	
Sandstone, shaly, (Upper Pittsburgh)	3	274	
Coal, Pittsburgh	8	282	222′
Conemaugh Series (333′)			
Concealed	11	293	

	Thickness. Feet.	Total. Feet.	
Sandstone, shaly, Lower Pittsburgh	28	321	
Concealed and shale	17	338	
Concealed	77	415	
Coal streak	0	415	
Concealed and shale	17.5	432.5	
Coal, Little Clarksburg	0.5	433	151′
Shale, yellow	5	438	
Concealed	44	482	
Sandstone, light brown and hard, (Morgantown)	24	506	
Concealed, mostly fire clay	2	508	75′
Shale, red	14	522	
Sandstone, shaly	8	530	
Concealed and red shale	28	558	
Sandstone, Grafton	15	573	
Shale, green	18	591	
Limestone, marine fossils, Lower Ames	1	592	
Shale	4	596	
Coal, Harlem	1	597	89′
Shale, red, Pittsburgh	8	605	
Sandstone, shaly to railroad grade at Rosemont	10	615	18′

A fine section of the underground rocks on the eastern border of Flemington district is revealed in the log of the **Pittsvein Coal Company well (713)**, located 0.5 mile northeast of Flemington, the record of which is published on pages 340-342 of Volume I(A) of the State Survey reports. The well penetrates the Devonian rocks a distance of slightly over 1000 feet.

COURTHOUSE DISTRICT.—Courthouse district, Taylor county, lies between Flemington district and the Valley river; hence, the outcropping rocks therein belong in the Monongahela, Conemaugh, Allegheny, and Pottsville series.

The following section was obtained for the eastern border of Courthouse district by combining hand-leveled sections measured by D. B. Reger with the log of the A. J. Bartlett Diamond Drill Boring (719), the record of which was published on pages 573-574 of Vol. II(A) of the State Survey reports. That portion of the section above the base of the Connellsville sandstone was measured from the summit of the high knob located about one mile south 25° west of the boring; and that portion from the base of the same sandstone down to the well mouth, was measured on the steep hill slope immediately west of the well:

Section at Webster, Courthouse District.

Upper Carboniferous (973')	Thickness. Ft.	In.	Total. Ft.	In.	
Monongahela Series (52')					
Concealed from summit of knob 1.1 miles S 25° W of boring (719)	15	0	15	0	
Coal streak, Redstone	0	0	15	0	
Limestone, yellow, Redstone	1	0	16	0	
Concealed	23	0	39	0	
Slate	4	0	43	0	
Coal, Pittsburgh	9	0	52	0	52'
Conemaugh Series (559')					
Concealed	98	0	150	0	
Sandstone, massive, brown, very coarse and pebbly, making cliff, Connellsville	27	0	177	0	125'
Concealed	12	0	189	0	
Sandstone	6	0	195	0	
Concealed	132	0	327	0	
Shale, brown and sandy	15	0	342	0	
Shale, dark, marine fossils, Ames	6	0	348	0	
Concealed and shale	7	6	355	6	
Coal, Harlem (Elevation of base, 1120' L-A. T.)	1	6	357	0	180'
Shale, limy	14	0	371	0	
Limestone, silicious, Ewing	10	0	381	0	
Shale, limy	5	0	386	0	
Sandstone, shaly	6	0	392	0	
Shale	5	0	397	0	
Sandstone, shaly	11	0	408	0	
Concealed	13	0	421	0	
Sandstone, green, fine	5	0	426	0	
Concealed	22	0	448	0	
Sandstone	10	0	458	0	
Concealed to top of boring (719)	13	0	471	0	114'
A. J. Bartlett Boring Record (719) (Elevation of well mouth 1006' L-A. T.)					
Yellow clay and gravel	10	6	481	6	
Fire clay and shale	6	4	487	10	
Shale	14	10	502	8	
Shale, limy	8	0	510	8	
Fire clay and black shale, Brush Creek	2	10	513	6	
Coal, Brush Creek	0	9	514	3	43.3'
Limestone, impure	12	11	527	2	
Fire clay	11	6	538	8	
Shale, light green	7	0	545	8	
Fire clay	17	6	563	2	
Sandy shale and sandstone, massive	32	3	595	5	
Shale, sandy	15	7	611	0	96.7'
Allegheny Series (181.2')					
Fire clay and shale	7	3	618	3	
Shale, sandy	5	0	623	3	
Shale, streaked with coal seams	11	0	634	3	
Coal, Lower Freeport	2	0	636	3	25.2'
Fire clay and sandy shale	19	11	656	2	
Limestone, dark, greenish gray, Lower Freeport	7	0	663	2	

	Thickness. Feet.	In.	Total. Feet.	In.	
Shale and fire clay with lime nodules.	14	0	677	2	
Sandy shale and micaceous sandstone	12	1	688	3	
Coal .....0′ 1″					
Black slate.0 2					
Coal 0 4					
Gray slate..1 2 Upper Kittanning.	4	9	693	0	56.7′
Black slate.1 6					
Coal 1 6					
Dark slate and sandy shale.....	13	4	706	4	
Limestone, Johnstown Cement Bed...	9	6	715	10	
Shale	10	0	725	10	
Black slate, thin seams of coal.....	2	0	727	10	
Fire clay.....	2	4	730	2	
Shale, sandy.....	6	10	737	0	
Coal .....0′ 2″					
Black slate.1 2					
Bony coal..0 2 Roaring Creek,					
Coal .....2 4 Lower Kittanning.	5	10	742	10	49.7
Bony coal..0 4					
Coal 1 8					
Fire clay, hard (Lower Kittanning)..	6	0	748	10	
Shale, sandy, some limestone.....	4	0	752	10	
Sand, hard, massive, light gray, Clarion	27	4	780	2	
Sand, or sandy shale, dark.....	12	0	792	2	49.3′
Pottsville Series (180.8′)					
Sand, hard, base pebbly coal streaks in center, Homewood-Roaring Creek	39	0	831	2	
Sand and sandy shale.....	31	10	863	0	
Sand, hard, white, pebbly, Upper Connoquenessing	60	0	923	0	
Dark sandstone with coal seams, Quakertown	3	0	926	0	
Sandstone, very hard conglomerate, Lower Connoquenessing to bottom..	47	0	973	0	180.8′

Owing to the dip of the strata to the northwest, the intervals and thicknesses of formations from the base of the Connellsville down to the top of the boring at 471′ are slightly less than they should be.

FETTERMAN DISTRICT.—Fetterman district occupies the northeastern portion of Taylor county; hence, the outcropping rocks therein belong in the Conemaugh, Allegheny and Pottsville series.

The following hand-leveled section was measured at the southern edge of Fetterman district southward from the summit of the hill located on the Grafton-Fetterman district line, 0.3 mile north of the mouth of Threeforks creek, to the level of Tygart Valley river, 0.2 mile below the mouth of the former

stream. The portion including the basal 20′ of the Conemaugh and the Allegheny series, was measured one mile eastward on the same stream:

Grafton Section.

Upper Carboniferous (404′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (334′)			
Sandstone, Grafton, capping knob, coarse brown and pebbly	35	35	
Concealed	4.5	39.5	
Shale, dark green, marine fossils, Ames	14	53.5	
Coal, Harlem (elevation, 1235′L-A. T.)	1	54.5	54.5′
Shale, red and variegated ("Pittsburgh Reds")	34	88.5	
Sandstone, coarse brown and soft, Saltsburg	27	115.5	
Fire clay (Bakerstown coal horizon)	1	116.5	62′
Shale, yellowish	17	133.5	
Concealed	55.5	189	
Sandstone, coarse, gray, massive, Buffalo	55	244	
Shale, dark, plant and marine fossils, Brush Creek	6.5	250.5	
Coal, Brush Creek	0.5	251	134.5′
Fire clay shale, gray	6	257	
Sandstone, shaly	11	268	
Sandstone, flaggy brown, medium grained, Upper Mahoning	17	285	
Shale, yellow, with iron ore nuggets	5	290	
Concealed to river ¼ mile west of mouth of Threeforks creek	24	314	
Concealed (1.2 miles to the eastward)	20	334	83′
Allegheny Series (70′)			
Concealed	10	344	
Sandstone, gray, massive, with iron oxide streaks, Upper Freeport	43	387	
Shale, sandy	3	390	
Slate, dark	2	392	
Coal 1′ 3″ Shale, gray 0 1 **Coal** 0 8 — **Lower Freeport coal**	2	394	60′
Fire clay shale	5	399	
Shale, sandy, to bed of Threeforks creek, one mile east of mouth of latter stream	5	404	10′

The following aneroid section was measured in the extreme northeast corner of Fetterman district, Taylor county, southwestward mostly along the hill road to the bed of Laurel run from the summit of the high knob located 0.4 mile northeast of the common corner to Taylor, Monongalia and Preston counties. Owing to the rapid dip of the strata to the south-

east, the intervals and thicknesses of formations are much greater in portions of the section than they should be, but the succession as shown is believed to be correct:

Section One Mile Northwest of Irondale, Fetterman District.

Upper Carboniferous (670′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (390′)			
Sandstone, Grafton, large quartz pebbles capping knob	30	30	
Concealed and shale, dark green, Ames, marine fossils	13.5	43.5	
Coal, Harlem (18″)	1.5	45	45′
Concealed, with pebbly sandstone (Saltsburg) at base	60	105	
Concealed	80	185	
Sandstone, massive, coarse and pebbly, Buffalo	105	290	245′
Shale, sandy	2	292	
Slate, black (Brush Creek)	3	295	
Concealed with reds near base	60	355	
Sandstone medium grained, Mahoning	35	390	100′
Allegheny Series (270′)			
Concealed (mostly sandstone)	75	465	
Concealed	26	491	
Coal opening, fallen shut, Upper Kittanning	4	495	105′
Concealed	39	534	
Black slate	1	535	
Fire clay	5	540	
Shale, sandy and shaly sandstone	30	570	
Concealed	31.3	601.3	
Coal 0′ 8″ Shale, gray 2 0 Coal 0 11 Slate, gray and hard 0 5 Coal, bony 0 7 Slate, black 0 11 Coal, soft 2 3 Slate, black 0 6 Coal, bony 0 6	(8′ 9″) Lower Kittanning (Elevation of base, 1355′ L-A. T.)	8.7	610	115′
Fire clay and concealed	19	629	
Coal blossom, Clarion (1330′ L-A.T.)	6	635	
Concealed	25	660	50′
Pottsville Series (10′)			
Sandstone, massive, Homewood, to bed of Laurel run at road forks, 1 mile northwest of Irondale	10	670	10′

The following hand-leveled section was measured at the southeastern edge of Fetterman district by D. B. Reger southwestward from the summit of the high knob, located 0.5 mile northeast of Thornton, to the bed of Threeforks creek at the

plant of the Thornton Fire Brick Company at the latter town. The section shows that the clay quarried by the latter for brick manufacturing purposes comes immediately over the Upper Freeport coal bed and correlates with the Uffington Shale:

Section at Thornton, Fetterman District.

Upper Carboniferous (599′)	Thickness. Feet.	Total. Feet.	
Conemaugh Series (540′)			
Sandstone, soft, Lower Pittsburgh, capping knob	10	10	
Concealed and shale	36	46	
Sandstone, coarse brown, Connellsville	50	96	
Coal streak, Clarksburg	0	96	96′
Concealed and red shale, Clarksburg	33	129	
Concealed	55	184	
Fire clay (spring, water) (Elk Lick coal horizon)	1	185	89′
Shale, brown	15	200	
Concealed	22	222	
Sandstone, Grafton, mostly concealed	37	259	
Concealed	17	276	
Shale, dark green, marine fossils, Ames	5	281	
Coal blossom, Harlem	0	281	96′
Shale, red, Pittsburgh	20	301	
Concealed	70	371	
Coal, Bakerstown (thickness concealed)	0	371	90′
Concealed	55	426	
Concealed, mostly sandstone (Buffalo)	38	464	
Coal, Brush Creek (thickness concealed)	0	464	93′
Concealed	2	466	
Sandstone, massive, Mahoning	22	488	
Fire clay, shale brown .....16′ / Fire clay, shale gray, plastic and flinty.....36 } (Thornton fire clay)	52	540	76′
Allegheny Series (59′)			
Coal, Upper Freeport (elevation, 1089′ L-A. T.) 4 feet to	0.3	540.3	
Fire clay, gray, Bolivar	2.7	543	
Concealed	12	555	
Shale, gray, silicious and micaceous	25	580	
Limestone, silicious, Upper Freeport	3	583	
Shale, gray, with limestone nuggets	10	593	
Concealed to Threeforks creek at northeast edge of Thornton	6	599	59′

KNOTTSVILLE DISTRICT.—Knottsville district occupies the southeastern corner of Taylor county; hence, its outcropping rocks belong in the Conemaugh, Allegheny, and Pottsville series. The following section was obtained in the

northern edge of the district by combining a hand-leveled section measured by D. B. Reger northeastward from the summit of a high knob located 0.4 mile southward from the mouth of Rocky branch, with the record of the shaft of the East Grafton Coal & Coke Company, the log of which was furnished by John Bailey, watchman for the latter company:

Section 1.5 Miles Southwest of Thornton, Knottsville District.

Upper Carboniferous (697')	Thickness. Feet.	Total. Feet.	
Conemaugh Series (565')			
Unrecorded from top of knob 0.4 mile southwest of shaft	340	340	
Concealed	40	380	
Sandstone, shaly	10	390	
Slate, black	1	391	
Coal .....0' 4 " Slate .....0 0¼ **Coal, good...2 4** (2' 8¼") **Bakerstown** Elevation, 1203' L-A. T.)	3	394	394'
Concealed	42	436	
Sandstone, concealed and sandstone	50	486	
Concealed	11	497	
Concealed along steep bluff	28	525	
Concealed	40	565	171'
Allegheny Series (132')			
Concealed to top of coal shaft	5	570	
Shaft Record (elevation top, 1050' L-A. T.)			
Unrecorded	45	615	
Coal, Lower Freeport	2	617	
Unrecorded to bottom of shaft	58	675	
Unrecorded in test boring	15	690	
Coal, Upper Kittanning	7	697	132'

According to Mr. Bailey, the coal at 45 feet in the shaft was prospected for about 300 yards, and varied from 1½ to 4 feet in thickness. Work had ceased on the shaft at that time (July 22, 1911). The coal at the bottom of the section was reported in a test boring at a depth of 120 feet at the shaft.

The following section was obtained on Flat run along the southwest border of Knottsville district by combining a hand-leveled section measured from the summit of the high knob located 0.7 mile northeast of Stonehouse, down the steep hill southeastward, with the logs of the E. E. McDaniel Coal Test Boring (725) and the Lucinda McDaniel No. 1 Well (726) on the same stream. Owing to the rapid dip of the strata to the northwest, the intervals and thicknesses of formations are con-

siderably less than they should be in that portion of the section above the top of the bore hole (725). E. H. Bennett at Stonehouse is authority for the well records:

Section at Stonehouse, Knottsville District.

Upper Carboniferous (1083')	Thickness. Ft.	In.	Total. Ft.	In.	
Conemaugh Series (432')					
Concealed and sandstone, Connellsville, capping knob 0.7 mile northeast of Stonehouse	39	0	39	0	39'
Concealed and limy shale	50	0	89	0	
Concealed	83	0	172	0	
Sandstone, coarse, brown and pebbly, Grafton	16	0	188	0	
Concealed	13	0	201	0	
Shale, dark brown, marine fossils, Ames	5	0	206	0	167'
Concealed	20	0	226	0	
Limestone, Ewing	5	0	231	0	
Concealed	26	0	257	0	
Concealed with shale along steep bluff	40	0	297	0	
Concealed	33	0	330	0	
Sandstone, shaly, Buffalo	22	0	352	0	
Concealed	17	0	369	0	
Coal, Brush Creek	1	0	370	0	164'
Shale and concealed to top E. E. McDaniel boring (725)	34	0	404	0	
E. E. McDaniel Diamond Drill Boring Record (725). (Elevation of well mouth, 1105' B-A. T.)					
Surface clay	22	0	426	0	
Sandstone, coarse	1	0	427	0	
Shale, Uffington	5	0	432	0	62'
Allegheny Series (276')					
Coal, Upper Freeport (elevation of base, 1075' B-A. T.)	1	2	433	2	
Black slate and shale, mixed	4	0½	437	2½	
Bone, streaked with coal	11	2	448	4½	
Shale, soft	7	6	455	10½	
Shale, mixed with silicious limestone boulders intermingled, Upper Freeport Limestone	20	6	476	4½	
Shale, soft	8	2	484	6½	
Shale, mixed and gritty	7	10	492	4½	
Sandstone, light gray	2	4	494	8½	
Black slate and sandstone mixed	0	4	495	0½	
Black slate	0	5½	495	6	
Coal, Lower Freeport	2	6	498	0	66'
Shale, dark	5	4	503	4	
Sandstone, fine, to horizon of top well (726)	4	8	508	0	
Lucinda McDaniel No. 1 Well Record (726) (Elevation of well mouth, 998' L-A. T.)					
Sandstone, fine, with bastard lime heavily intermingled	6	7	514	7	

		Thickness. Feet.	In.	Total. Feet.	In.	
Sand, fine, blue and mixed....6' 10"						
Sand, light blue.7 11						
Shale, mixed, hard 8 0						
Sand, fine blue, whetstone 2 9	Lower Freeport					
Shale, mixed and gritty 7 11	Sandstone ..	34	0	548	7	50.6
Sand, hard and white to bottom 0 7						
Unrecorded		49	5	598	0	
Coal (Lower Kittanning).....		4	0	602	0	
Unrecorded 106		0		708	0	
Pottsville Series (375')						
Sand (Homewood)		40	0	748	0	
Unrecorded		10	0	758	0	
Sand (Upper Connoquenessing).....		60	0	818	0	110'
Slate		97	0	915	0	
Coal, Quakertown?		4	0	919	0	101'
Slate		79	0	998	0	
Sand (Sharon)		85	0	1083	0	164'
Lower Carboniferous (765')						
Mauch Chunk Series (251')						
Red rock		55	0	1138	0	
Unrecorded and lime		175	0	1313	0	
Unrecorded		21	0	1334	0	251'
Greenbrier Limestone (134')						
Big Lime (big water at 880').....		134	0	1468	0	134'
Pocono Sandstones (380').						
Sand, Big Injun.....		130	0	1598	0	
Unrecorded		200	0	1798	0	
Sand, Fifty-foot? (Berea).....		50	0	1848	0	380'
Devonian (1152')						
Catskill Series (850')						
Slate (water, bottom).....		20	0	1868	0	
Sand, Thirty-foot? (Gantz and Fifty-foot)		170	0	2038	0	
Sand (Thirty-foot)		50	0	2088	0	
Lime		20	0	2108	0	
Red Rock		163	0	2271	0	
Sand, Gordon		12	0	2283	0	
Slate, shells and unrecorded.....		165	0	2448	0	
Sand, Bayard		50	0	2498	0	
Slate and shells.....		200	0	2698	0	850'
Chemung (302')						
Slate and shells and concealed.....		302	0	3000	0	302'
(10" casing, 157'; 8" casing, 600'; 6" casing, 1100')						

The following is a record of a coal test boring (724) drilled in 1904 by the Mohawk Smokeless Coal Company. This boring as well as No. 725 was put down with a churn drill,

but a core was taken out of the coals. The well starts 115 feet by aneroid below the Brush Creek coal exposed in the hill directly northeast of the boring; hence, according to the section above, the base of the Conemaugh series comes 35 to 40 feet above the well mouth:

E. H. Bennett No. 2 Coal Test Boring Record (724).

Located in Knottsville District, 0.2 mile north of Stonehouse

Upper Carboniferous (139.7') Allegheny Series (139.7')		Thickness. Ft.	In.	Total. Ft.	In.	
Surface (elevation, 1022' L-A. T.)		1	0	1	0	
Clay		5	0	6	0	
Sandstone		2	3	8	3	
Shale		18	3½	26	6½	
Slate		0	1½	26	8	
Coal, Lower Freeport		1	6	28	2	28.2'
Fire clay		1	0	29	2	
Shale, mixed with sandstone (Lower Freeport)		37	0½	66	2½	
Sandstone (Lower Freeport)		11	4½	77	7	
Sandstone and shale mixed		7	2	84	9	
Slate		0	3	85	0	
Coal, Upper Kittanning "rider"		1	6	86	6	
Shale and fire clay		2	0½	88	6½	
Black slate with shale at bottom		1	5½	90	0	
Coal, slaty, "roof" ....0' 4" Parting ....0 1½ Coal, sulphurous.....1 2¾ Parting, with ¾" of coal between...0 2¼ Coal 0 2	(Upper Kittanning coal)	2	0½	92	0½	63.9'
Hard fire clay or shale		0	3½	92	4	
Shale		27	3¼	119	7¼	
Slate		0	10½	120	5¾	
Coal .....0' 1" Coal and slate parting ...0 1¼ Coal 0 10	(Middle Kittanning coal)	1	0¼	121	6	29.4'
Fire clay		0	3	121	9	
Shale		4	3½	126	0½	
Sandstone		0	3½	126	4	
Slate		7	2	133	6	

		Thickness. Feet.	In.	Total. Feet.	In.	
Coal .....0′ 1″						
Slate 0 6¾						
Coal 0 0¾						
Slate 0 2½	Lower Kittanning coal	5	11¾	139	5¾	18′
Coal with 4″ of bone intermingled.1 9½						
Parting 0 3						
Coal 3 0¼						
Fire clay to bottom of hole.....		0	3	139	8¾	0.2′

The above boring record is interesting in that all three of the Kittanning group of coals appear to be represented.

The following hand-leveled section was measured in the southern edge of Knottsville district from the summit of the high knob located 0.5 mile northwest of Cecil, southwestward to the bed of the river 200 yards below Cecil railroad station. The basal 66 feet of the section was supplied from exposures on the south, or opposite side of the river. The Allegheny series has thinned away 40 to 60 feet from its usual thickness in the northern portion of the State:

Section at Cecil, Knottsville District.

Upper Carboniferous (726′) Conemaugh Series (506′)	Thickness. Feet.	Total. Feet.	
Concealed and variegated shale from top knob ½ mile northwest of Cecil.....	34	34	
Sandstone massive coarse brown, Connellsville	30	64	64′
Concealed and red variegated shale, Clarksburg	38	102	
Sandstone, massive.....	5	107	
Reds, dark, purplish.....	15	122	
Reds	20	142	
Concealed, mostly sandstone, Morgantown..	52	194	
Sandstone, massive, coarse, brown and pebbly, Grafton.....	35	229	
Concealed	6	235	
Shale, dark green, marine fossils, Ames....	1	236	172′
Concealed	20	256	
Concealed, mostly reds, Pittsburgh.....	27	283	
Sandstone, shaly, Saltsburg, forms steep bluff	25	308	
Concealed	10	318	
Shale, sandy and dark gray.....	6	324	
Coal, Bakerstown, (old opening).....	3	327	91′
Concealed	32	359	
Concealed along bench.....	17	376	

	Thickness. Feet.	Total. Feet.	
Sandstone and sandy shale, forming steep bluff	30	406	
Concealed	5	411	
Concealed along bench	18	429	
Sandstone, massive, with large quartz pebbles near base, Mahoning	14	443	
Concealed along bench	20	463	
Concealed, steep slope	3	466	
Fire clay shale	20	486	
Concealed along bench	20	506	179′
Allegheny Series (180′)			
Concealed along bench	10	516	
Shale	6	522	
Sandstone, buff, massive, Upper Freeport	13	535	
Concealed, mostly sandstone	32	567	
Coal, Lower Freeport	1	568	62′
Concealed and shale	10	578	
Sandstone, massive Lower Freeport	42	620	
Coal 1′ 6″ Fire clay and shaly sandstone 4 0 **Cannel slate** 0 6 **Coal, concealed,** estimated 4 0 — **Upper Kittanning**	10	630	
Fire clay and concealed	5.5	635.5	
Limestone, gray and hard, Johnstown Cement bed	2.5	638	
Shale and concealed to railroad grade 200 yards west of Cecil Station	8	646	
Concealed to top Lower Kittanning coal in river bed	14	660	
Coal, bony 0′ 10″ Coal, good 1 8 Coal, bony 1 0 Coal, good 2 4 Shale, gray 0 2 Coal, good 0 4 — **Lower Kittanning** (Section on opposite side of river) (Roaring Creek)	6.3	666.3	36.3′
Fire clay and concealed	20	686	20′
Pottsville Series (40′)			
Sandstone, massive, pebbly, white, Homewood	40	726	40′

The section is very important, in that accurate measurements are given from the well known **fossiliferous Ames shale** to established formations of the Conemaugh and Allegheny series. The presence of the Johnstown Cement limestone therein fixes the correlation of the Upper Kittanning coal, the latter coming about 115 feet below the top of the Allegheny series.

SUMMARY.

The following table gives not only the thickness in many instances of the Upper Carboniferous, Lower Carboniferous, and Devonian as shown by the foregoing general sections, but it also exhibits in many cases the thickness of the several series under each. The sections have been arranged in alphabetical order for the places at which they were measured. Under the columns showing thicknesses and totals the short row of dots indicates that the series was not represented in the section, while the dash line in parenthesis indicates that the formations were present but not separated from the contiguous series:

Table Showing Thickness in Feet of the Stratified Rocks in the Monongalia-Marion-Taylor Area.

PLACE MEASURED	UPPER CARBONIFEROUS						LOWER CARBONIFEROUS				DEVONIAN			Total Section
	Dunkard	Monongahela	Conemaugh	Allegheny	Pottsville	Total	Mauch Chunk	Greenbrier Limestone	Pocono Sandstone	Total	Catskill	Chemung	Total	
Aaron Creek	.....	.....	285	124	.....	409	.....	.....	.....	.....	839	.....	.....	409
Anita	.....	.....	306	183	.....	489	.....	.....	.....	.....	.....	.....	.....	489
Barrackville	254	180	.....	.....	.....	434	.....	.....	.....	.....	.....	.....	.....	434
Beaverhole	.....	.....	.....	274	914	1189	226	92	296	676	.....	.....	.....	1189
Beechwood	.....	67	350	.....	.....	417	.....	.....	.....	.....	.....	.....	.....	417
Behler	528	350.6	.....	.....	.....	878.6	.....	.....	.....	.....	.....	.....	.....	878.6
Cassville	567	384	585	252	271	2059	147	60	461	638	839	17	886	3583
Cecil	.....	.....	506	180	40	726	.....	.....	.....	.....	.....	.....	.....	726
Cheatview	.....	.....	.....	.....	185	185	299	110	520	829	85	.....	85	1019
Clinton Furnace	.....	.....	150	195	.....	345	.....	.....	.....	.....	.....	.....	.....	345
Crossroads	988	375	.....	.....	.....	1363	.....	.....	.....	.....	.....	.....	.....	1363
Dakota	211.5	195.5	.....	.....	.....	410	.....	.....	.....	.....	.....	.....	.....	410
Downs	410	407	593	202	261	1873	177	105	104	386	.....	.....	.....	2259
Easton	.....	100	545.8	.....	.....	645.8	.....	.....	.....	.....	.....	.....	.....	645.8
Fairview	692	397	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1089
Farmington (Underwood)	319	393.4	.....	.....	.....	712.4	.....	.....	.....	.....	.....	.....	.....	712.4
Glover Gap	940	258	530	212	331	2380	123	87	500	710	251	.....	251	3341
Grafton	.....	.....	334	70	.....	404	.....	.....	.....	.....	.....	.....	.....	404
Hammond	.....	.....	(205)	(....)	(....)	500	.....	.....	.....	.....	.....	.....	.....	500
Ices Run-Fairmont	207	393.8	1.6	.....	.....	602.4	.....	.....	.....	.....	.....	.....	.....	602.4
Irondale	.....	.....	390	270	10	670	.....	.....	.....	.....	.....	.....	.....	670
Little Falls	.....	.....	532.5	38.5	.....	571	.....	.....	.....	.....	.....	.....	.....	571
McClaren (W. of Easton)	.....	.....	318.6	77.4	.....	396	.....	.....	.....	.....	.....	.....	.....	396
Mannington	507	395	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	902
Meadland	.....	100	395	.....	.....	495	.....	.....	.....	.....	.....	.....	.....	495
Monongah-NW	491.5	381.2	1.2	.....	.....	573.9	.....	.....	.....	.....	.....	.....	.....	573.9
Monongah-SE	25	431	.....	.....	.....	456	.....	.....	.....	.....	.....	.....	.....	456
Mooresville	675	382.2	0.8	.....	.....	1058	.....	.....	.....	.....	.....	.....	.....	1058
Montana Mines	.....	243	607	230	260	1340	250	68	365	683	800	684	1484	3507
Morgan Run	.....	130	602	239	282	1253	177	85	520	782	815	101	949	2984
Morgantown	.....	55	605.5	238.5	205	1144	.....	.....	.....	.....	.....	.....	.....	1144
Mt. Chateau Hotel	.....	.....	135	240	205	580	.....	.....	.....	.....	.....	.....	.....	580
Powell	.....	.....	477	226	199	602	.....	.....	.....	.....	.....	.....	.....	602
Quarry Run	.....	.....	.....	.....	187.3	187.3	300	85	(....)	(....)	(....)	.....	(....)	1272.3
Randall (Jimtown)	.....	297	166	.....	.....	463	.....	.....	.....	.....	.....	.....	.....	463
Rivesville	405	170	.....	.....	.....	575	.....	.....	.....	.....	.....	.....	.....	575
Rock Forge	.....	.....	296	150.3	.....	446.3	.....	.....	.....	.....	.....	.....	.....	446.3
Rohr	.....	.....	.....	.....	320	320	(....)	(....)	519	835	.....	.....	.....	1155
Sabraton	.....	45	599	148.2	.....	792.2	.....	.....	.....	.....	.....	.....	.....	792.2
St. Cloud	1066	350	550	259	279	2504	128	74	577	779	651	.....	651	3934
Stonehouse	.....	.....	432	276	375	1083	251	134	380	765	850	302	1152	3000
Sturgisson	.....	.....	.....	.....	(. ..)	(....)	(....)	160	40	(....)	.....	.....	.....	490
Thornton	.....	.....	540	59	.....	599	.....	.....	.....	.....	.....	.....	.....	599
Thornton-SW	.....	.....	565	132	.....	697	.....	.....	.....	.....	.....	.....	.....	697
Triune	.....	.....	158	213	.....	371	.....	.....	.....	.....	.....	.....	.....	371
Tyreonnell Mines	.....	274	341	.....	.....	615	.....	.....	.....	.....	.....	.....	.....	615
Van Voorhis	.....	.....	532.3	94.4	.....	626.7	.....	.....	.....	.....	.....	.....	.....	626.7
Webster	.....	52	559	181.2	180.8	973	.....	.....	.....	.....	.....	.....	.....	973
Whetstone Run	650	395	559	(....)	(....)	(....)	(....)	90	500	(....)	356	.....	356	3248
Worthington	204	322	.....	.....	.....	526	.....	.....	.....	.....	.....	.....	.....	526

The foregoing sections from Monongalia-Marion-Taylor area give a maximum thickness of the outcropping rocks in this portion of the State of 3825 feet, divided as follows:

	Feet.	
Upper Carboniferous:		
Dunkard Series	1066	
Monongahela Series	431	
Conemaugh Series	607	
Allegheny Series	276	
Pottsville Series	375	2755 feet.
Lower Carboniferous:		
Mauch Chunk Series	335	
Greenbrier Limestone	160	
Pocono Sandstones	575	1070 feet.
Total		3825 feet.

CHAPTER V.

STRATIGRAPHY—DUNKARD SERIES.

The Dunkard series is the highest division of the Carboniferous system of rocks in the Appalachian area of North America, and, except the alluvium along the stream bottoms and old terrace deposits, it is the most recent formation in the Monongalia-Marion-Taylor area. The series was so named from Dunkard creek, a stream flowing eastward into the Monongahela river in the southwestern corner of the State of Pennsylvania, by I. C. White, whose original description is as follows[1]:

"The uppermost beds are found at the headwaters of Dunkard creek, a large stream which heads near the West Virginia-Pennsylvania line, on the eastern slope of the water-shed separating the Ohio and Monongahela river drainage systems, and flowing eastward, puts into the Monongahela two miles above Greensboro, Greene county, Pennsylvania, and four miles north from the West Virginia line. This stream flows over the Permo-Carboniferous rocks from its source to the point at which it leaves the West Virginia line at Mount Morris, Pennsylvania, a distance of more than thirty miles, furnishing very fine exposures of these rocks along its banks and bluffs; hence, the geographical name, Dunkard, which I have given the series."

This group of rocks was first called the **Upper Barren measures** on the supposition that it contained no coal beds of economic value, and for a long time was placed under the compromise term, **Permo-Carboniferous,** on account of the presence of fossil plants of the Permian age in its shales and slates, and the failure to find a Permian fauna.

The base of the series was placed by I. C. White where Permian plants were first observed in the fossil flora, viz.: the Cassville shale immediately over the Waynesburg coal.

In West Virginia and in the area under discussion, this group of rocks consists largely of a succession of brown and grayish green sandstones, interstratified with red shales, a few

1 Bulletin 65, U. S. G. Survey, I. C. White; page 20; 1891.

thin limestones, and several thin and unimportant coal beds with the possible exception of the Washington coal. The soils formed from the disintegration of these rocks bears a great reputation for producing a fine grade of wool, and for this reason that portion of the State where these measures come to the surface, is often referred to as the "sheep belt," since by far the greater percentage of the fine wool sheep raised in West Virginia are grown on the outcrop of the Dunkard rocks.

The following general section of the Dunkard series includes all known and described formations to the date of this report, and is a slight modification of the same published on pages 134 and 135 of the Doddridge-Harrison report by the writer:

General Section, Dunkard Series, for West Virginia:

	Thickness. Feet.	Total. Feet.	
Sandstone, flaggy, (Upper Proctor)	40	40	
Shale	15	55	
Sandstone, (Middle Proctor)	25	80	
Shale	10	90	
Sandstone, massive, green, micaceous (Lower Proctor)	25	115	
Shale, red and variegated	35	150	
Limestone, Windy Gap	5	155	
Sandstone, massive, (St. Cloud)	20	175	
Shale, sandy	4	179	
Coal, slaty, Windy Gap, 3" to	1	180	180'
Fire clay, shale, red, and variegated, with layers of limestones and sandstones	80	260	
Sandstone, massive, Gilmore	30	290	110'
Coal, (Gilmore)	1	291	
Limestone, (Gilmore)	1	292	
Shale, variegated and red, with thin sandstones	93	385	
Limestone, Upper (Rockport)	5	390	
Sandstone, (Taylor)	30	420	
Limestone, Middle (Rockport)	5	425	
Sandstone, and shale, buff and red	29	454	
Coal, (Nineveh "A") 3" to	1	455	65'
Limestone, (Lower Rockport)	5	460	
Shale, brown and variegated	15	475	
Sandstone, massive, coarse and brown, Nineveh	25	500	
Shale, 1' to	4	504	
Coal, Nineveh	1	505	50'
Fire clay and limy shale	10	515	
Limestone, Nineveh	5	520	
Shale, variegated and red	30	550	

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, (Burton)	29	579	
Coal, Hostetter	1	580	75′
Shale, sandy, with thin sandstones	60	640	
Sandstone, massive, (Fish Creek)	34	674	
Coal, (Fish Creek)	1	675	95′
Fire clay shale, (Fish Creek)	5	680	
Shale, sandy and red, with thin sandstones	29	709	
Sandstone, massive, (Rush Run)	25	734	
Shale, sandy	5	739	
Coal, Dunkard	1	740	65′
Fire clay and shale, red, sandy and variegated.	29	769	
Sandstone, (Jollytown)	20	789	
Coal, Jollytown	1	790	50′
Fire clay	1	791	
Limestone, Upper Washington	4	795	
Shale, limy	5	800	
Sandstone, (Hundred)	34	834	
Coal, (Hundred) (5″) to	1	835	44′
Fire clay and red and variegated shale	34	869	
Sandstone, (Upper Marietta)	50	919	
Coal, Washington "A"	1	920	85′
Shale, red, (Creston)	60	980	
Limestone, Middle Washington	5	985	
Sandstone, (Lower Marietta)	40	1025	
Limestone, Lower Washington	2	1027	
Coal, Washington	3	1030	110′
Fire clay shale, (Washington)	10	1040	
Limestone, (Bristol)	2	1042	
Sandstone, Washington	10	1052	
Coal, Little Washington	1	1053	
Shale	7	1060	
Sandstone, (Mannington) (Waynesburg "B" coal horizon near middle)	45	1105	
Shale	4	1109	
Coal, Waynesburg "A"	1	1110	80′
Fire clay and shale	3	1113	
Limestone, Mt. Morris	2	1115	
Shale	12	1127	
Sandstone, coarse, brown and pebbly, Waynesburg	45	1172	
Limestone, dark flaggy, (Elm Grove)	3	1175	
Shale, dark, sandy with fossil plants, Cassville	5	1180	70′
Coal, Waynesburg.			

The names in parentheses—25 in number—have all been added by the writer and others since the publication of the original Dunkard Creek section by I. C. White on page 22 of Bulletin 65 of the U. S. G. Survey in 1891.

The crop of the Dunkard series in the area under discussion is confined entirely to those portions of Monongalia and Marion counties lying west of the Monongahela and

Photo by Ray Bricker.

PLATE XI.—Topography of the Dunkard Series, at summit between Indian Creek and Pharoah Run, ½ mile southwest of Arnettsville, Monongalia County.

Tygart Valley rivers, and just catches the summits of the highest hills in the Ligonier Basin southwest of Flemington in Taylor county. The extent of this rock group is graphically exhibited on Map II. The maximum thickness of these measures left uneroded—1090 to 1100 feet—occurs at Honsocker Knob near St. Cloud, in the northwest corner of Monongalia county, and at the high knob at the common corner to Marion, Harrison and Wetzel counties. The summit of the former knob reaches an elevation of 1646′ L-A. T., while the base of the Pittsburgh coal or base of the Monongahela series is only 206′ L-A. T. in the Barney Renner No. 2238 well (36) located on the southeast side of the Knob. The thickness of the Monongahela series as shown by the St. Cloud section, page 92, is only 350 feet; hence, 1090 feet are left for the Dunkard rocks—90 feet less than that published for the Steels Run, Wetzel county, Section[2], the latter being the maximum yet reported for the Appalachian area. Allowing 390 feet for the thickness of the Monongahela series at the second knob, there remains above about 1100 feet of Dunkard rocks.

MONONGALIA COUNTY SECTIONS, DUNKARD SERIES.

In the preceding chapter of this report, the rock succession of the Dunkard series in Monongalia county is exhibited in several of the general sections, and special reference is here made to the St. Cloud and Behler sections. In addition, two sections—one in Battelle and the other in Clay district—of this group of rocks will now be given.

The following hand-leveled section was measured along the northern border of Battelle district from the summit of the high knob, located 0.5 mile southeast of Maple, southward along the hill road to the Thos. White No. 1 gas well (10) on Brushy fork. The section is very important in that it exhibits the true relative positions of the Lower Rockport limestone, and the Nineveh, Hostetter, Fish Creek, Dunkard and Jollytown coals.

2. Marshall-Wetzel-Tyler Report, page 106; 1909.

The Nineveh-Hostetter coal interval is 12 feet greater than that given by the writer in the Burton, Wetzel county, Section on page 110 of the Marshall-Wetzel-Tyler County report The Jollytown-Nineveh coal interval is shown to be 252 feet:

Section Near Maple, Battelle District.

	Thickness. Feet.	Total. Feet.	
Concealed from top of knob	16	16	
Sandstone	25	41	
Shale, dark (1") and shale, gray	5	46	
Shale, red	16	62	
Shale, sandy	32	94	
Sandstone, soft, friable	15	109	
Concealed to road forks (U. S. G. S. 1352' A. T., map)	5	114	
Shale, buff and sandy	26	140	
Sandstone, massive, Taylor	10	150	
Shale, buff	9	159	
Shale, dark, and fire clay	3	162	162'
Limestone, gray and hard, silicious, with shale layers, Lower Rockport	8	170	
Shale, gray and limy	4	174	
Sandstone, shaly, Nineveh	13	187	
Shale, sandy	10	197	
Concealed	6	203	
Coal, Nineveh (1262' L-A. T.)	1	204	42'
Concealed	20	224	
Fire clay shale	5	229	
Sandstone, massive, and shale	25	254	
Sandstone, massive, Burton	10	264	
Shale, dark	1	265	
Fire clay shale	4	269	
Sandstone	5	274	
Shale, red	15.7	289.7	
Coal, Hostetter (1176' L-A.T.)	0.3	290	86'
Fire clay shale	5	295	
Shale, variegated	18	313	
Sandstone	4	317	
Shale, variegated and red, with ferriferous limestone nuggets	21	338	
Sandstone, shaly	5	343	
Shale, sandy	10	353	
Concealed	5	358	68'
Fire clay shale, Fish Creek (top 1108' L-A. T.).	5	363	
Sandstone and concealed	47	410	
Coal, Dunkard, bed of Brushy fork (1055' L-A. T.) to level of Thos. White No. 1 well (10)	1	411	53'
Concealed	5	416	
Shale, buff	5	421	
Sandstone, massive, Jollytown	10	431	
Shale, sandy	5	436	

PLATE XII.—Topography of the Dunkard Series, from hill above Georgetown, Monongalia County, looking toward Little Indian Creek.

	Thickness. Feet.	Total. Feet.	
Shale, dark	1	437	
Shale, gray, concealed and shale	19	456	
Coal, Jollytown	1	457	46′
Unrecorded in Thos. White No. 1 well (10).	404	861	404′
Coal, Waynesburg.			

The Dunkard coal crops in the bed of Brushy fork a short distance above the well (10), almost flush with the top of the latter. In this boring the top of the Pittsburgh coal was struck at a depth of 785 feet, which gives an accurate measurement for the Dunkard-Pittsburgh coal interval near the type locality of the former bed. That portion of the section from 411 to 457 feet was measured 0.5 mile northward from the White well (10) along the road leading from Brushy fork eastward to the head of Pumpkin run.

The following aneroid section was measured in the northwest corner of Clay district from the summit of the high knob located near the cross-roads, 2 miles northwest of Daybrook, northwestward along the hill road to the crop of the Jollytown coal. The Dunkard-Jollytown coal interval is slightly greater than it should be owing to a slight dip in the strata in the direction in which the section was measured:

Section Two Miles Northwest of Daybrook, Clay District.

	Thickness. Feet.	Total. Feet.	
Concealed from summit of knob to cross roads.	100	100	
Sandstone, massive, Burton	29	129	
Concealed and fire clay	1	130	
Concealed	10	140	
Shale	10	150	
Fire clay shale	10	160	
Sandstone, massive, Fish Creek	30	190	
Concealed	45	235	
Coal, blossom, Dunkard	0	235	235′
Concealed and fire clay	5	240	
Shale, brown	5	245	
Sandstone, massive, Jollytown	30	275	
Concealed	21	296	
Shale, gray	2	298	
Coal 1′ 6″ Shale, gray 0 3½ **Coal** 0 3½	2 (25″) Jollytown coal (elevation, 1140′B-A. T.)	300	65′
Fire clay and gray shale	3	303	
Sandstone, limy and nodular, Upper Washington limestone horizon	4	307	7′

The base of the section comes about 190 feet above the Pittsburgh coal horizon, and allowing 360 feet for the thickness of the Monongahela series, there still remains 430 feet of the Dunkard series below the base of the section, giving the total for these measures in this portion of Monongalia about 740 feet.

MARION COUNTY SECTIONS, DUNKARD SERIES.

As with Monongalia the rock succession of the Dunkard series in Marion county is exhibited in several of the general sections for that area in the preceding chapter. In addition the following aneroid section was measured in the northern portion of Mannington district from the summit of the high knob, located 1 mile northeast of Metz, southwestward along the hill road to the mouth of Johnnycake run. The base of the section comes about 725 feet above the Pittsburgh coal:

Section Near Metz, Mannington District.

	Thickness. Feet.	Total. Feet.	
Concealed from summit of knob to road, low gap	125	125	
Shale, buff sandy, variegated	40	165	
Sandstone, shaly	15	180	
Shale, red and variegated	15	195	
Sandstone, green shaly	10	205	
Concealed	20	225	
Sandstone	5	230	
Concealed	25	255	
Sandstone, shaly	25	280	
Red shale	5	285	
Shale, buff sandy	15	300	
Concealed	40	340	
Fire clay	1	341	
Concealed	24	365	
Shale, dark red	5	370	
Shale	3	373	
Sandstone, shaly, Rush Run	22	395	395′
Concealed	20	415	
Sandstone, Jollytown	25	440	
Shale	5	445	
Coal 0′ 7″ Shale, gray 0 3 Coal 1 0 (22″) Jollytown coal. (1080′B-A. T.)	2	447	52′
Fire clay and concealed	8	455	
Sandstone	10	465	

	Thickness. Feet.	Total. Feet.	
Shale	40	505	58′
Coal blossom, Hundred	0	505	
Concealed to mouth of Johnnycake run	25	530	25′

DESCRIPTION OF THE DUNKARD FORMATIONS.

The character and distribution of the several formations of the Dunkard series in the Monongalia-Marion-Taylor area will now be described in detail.

The Proctor Sandstones.

The highest formations yet described in the Appalachian area for the Dunkard series are the Proctor[3] sandstones which at their type locality have a thickness of 150 feet and come about 1300 feet above the Pittsburgh coal. In the St. Cloud section, page 92, the writer has separated these ledges into the **Upper Proctor, Middle Proctor** and **Lower Proctor sandstones.**

In **Monongalia county** their crop is confined to the summits of the high knobs which attain an elevation of 1550′ to 1650′A.T. along the axis of the Robinson and Waynesburg synclines. The Crossroads section reports what appears to be the Lower Rockport sandstone, coming 1310 feet above the Pittsburgh coal.

In **Marion county** the crop of these sandstones is confined as in Monongalia, to the summits of the high knobs, attaining about the same elevation along the axes of the same synclines. No quarries were observed on these ledges.

The St. Cloud Sandstone.

At 4 to 5 feet above the Windy Gap coal at St. Cloud postoffice in the northwestern border of Battelle district, Monongalia county, there occurs a massive, micaceous, medium-grained sandstone, 15 to 20 feet thick, which has been desig-

3. Hennen, Ray V., Marshall-Wetzel-Tyler Report, W. Va. Geol. Survey, page 167; 1909.

nated by the writer the **St. Cloud sandstone** from that place. It is this stratum that forms the cliff on the head of Cappo run, 0.4 mile north 20° west of St. Cloud, where it was once quarried for building purposes on the land of Isaiah Jones. This sandstone caps the summit of Efaw knob, 1.3 miles northeast of Wadestown. Its crop in both Monongalia and Marion counties is confined to practically the same areas as that outlined for the Proctor sandstones.

The **Windy Gap limestone** of I. C. White was not observed at any point in the area under discussion.

The Windy Gap Coal.

The highest known and described bituminous formation of the Dunkard series is the **Windy Gap coal**, which has been so designated by I. C. White[4] from a gap of that name along the southern border of Aleppo township, Greene county, Pa., where, according to levels made by the writer, it comes 1290 feet above the Pittsburgh coal. In the area under discussion the crop of this coal is confined to practically the same territory as that outlined for the St. Cloud and Proctor sandstones.

In **Monongalia county** this coal was observed at five different points, one of which is at the south edge of the ridge road, about 100 feet east of M. L. White's store at St. Cloud, Battelle district. Here 3 inches of shaly coal is exposed at an elevation of 1495′ A. T. by aneroid. Its relative position to other formations of the Dunkard series at this place is given in the St. Cloud section, page 92.

It crops in the road, 0.1 mile northeast of the common corner to Monongalia, Marion and Wetzel counties at an elevation of 1490′ A. T. by level spirit. Here it is 6 inches thick and quite slaty, coming about 1300 feet above the Pittsburgh coal.

Passing to the southeast portion of Battelle district, this coal is found cropping at an elevation of 1530′ A. T. on the ridge road at the head of Range run, 1.3 miles northwest of Galletin, where the following section was measured:

4. Bulletin 65, U. S. G. Survey, p. 31; 1891.

	Ft.	In.
Shales, sandy	10	0
Shales, limy	5	0
Coal, slaty, Windy Gap	0	5
Shales, limy	2	0

Here the coal comes about 1300 feet above the Pittsburgh bed.

About the same thickness of slaty coal is exposed at this horizon along the ridge road at an elevation of 1625′ A. T. by aneroid, 1.3 miles northeast of Galletin, coming there 1300 feet over the Pittsburgh coal.

In **Marion county** this coal was not observed at any point, although its horizon should catch the summits of the highest hills along the axes of the Robinson and Waynesburg synclines. In the area under discussion it does not attain sufficient thickness to have any economic importance, but is of special scientific interest as being the highest (geologically) known bituminous formation in the Appalachian area.

The Gilmore Sandstone.

The next important stratum in descending order in the Dunkard series is the Gilmore sandstone, so designated by J. J. Stevenson from the township of that name in southwestern Greene county, Pa., where it is a conspicuous cliff former near the hill summits in the southwestern portion of the township, slightly over a mile northward from the Battelle district line. It is a massive bed of coarse, yellowish gray and brown sandstone, whose cliffs are generally traversed by fissures, furnishing retreats for foxes, and for that reason is often locally known as the "Fox Rocks." At its type locality this ledge comes 215 feet above the base of the Nineveh coal, and about 1200 feet above the Pittsburgh bed.

In **Monongalia** and **Marion counties** this stratum forms a prominent escarpment around the hillsides near the summits of the high knobs and ridges along and near the axes of the Robinson and Waynesburg synclines. The Crossroads section, page 94, shows it 35 feet thick, 207 feet above the Nineveh limestone, 476 feet above the Jollytown coal, and

1235 feet above the Pittsburgh coal. No quarries were observed on this ledge in the area under discussion, yet it has been quarried one mile northward to some extent at its type locality in Gilmore township.

The Gilmore Coal.

At the base of the Gilmore sandstone there frequently occurs a few inches of coal that has been named the **Gilmore**[5] from its association with the sandstone above. It comes 215 to 230 feet above the Nineveh coal and about 1200 feet above the Pittsburgh bed.

In the area under discussion the crop of its horizon is confined to the same territory as outlined for the Gilmore sandstone. Actual coal at this horizon was observed at only one point in Monongalia and Marion. This was in the northwestern part of Battelle district, Monongalia, along the hill road on the head of Brushy fork, 0.5 mile northeast of St. Cloud, where the following section was measured:

	Ft.	In.
Shale	6	0
Coal, shaly, Gilmore	0	3
Fire clay	0	6
Limestone, gray and hard, Gilmore	1	0

Here the coal comes at an elevation of 1442′ A. T. by spirit-level measurement, 225 feet by hand-level above the Nineveh coal in the hill road, 0.2 mile northwestward, and 1210 feet above the Pittsburgh bed as given in the S. L. S. Spragg No. 1 well (4), 0.3 mile northwestward. As with the Windy Gap coal, it has no economic value, but is fairly persistent in western Monongalia and eastern Wetzel counties, West Virginia, and in southwestern Greene county, Pa.

5. Ray V. Hennen, Marshall-Wetzel-Tyler Report, W. Va. Geol. Survey, p. 172; 1909.

The Gilmore Limestone.

Immediately under the Gilmore coal in the vicinity of Littleton and Uniontown, Wetzel county, there occurs a dark gray, slightly silicious limestone, 6 to 12 inches thick, that appears to be a fairly persistent formation of the Dunkard series. In the Monongalia-Marion-Taylor area, the crop of its horizon is confined to practically the same territory as outlined for the Gilmore sandstone. However, it was observed at only one locality. This was along the ridge road northeastward from St. Cloud in Battelle district. The section given above under the "Gilmore Coal" was measured at its exposure along this road. It is this limestone that crops in the road about 200 feet southwest of the Oak Forest M. E. church, 0.2 mile northeast of St. Cloud, where it is quite silicious and more or less lenticular. It does not attain sufficient thickness to have any economic importance. It was so named[6] from its association with the overlying coal and sandstone.

The **Upper Rockport limestone** was not observed at any point in either county.

The Taylor Sandstone.

At 120 feet below the Gilmore sandstone and 70 feet above the Nineveh coal, there occurs a very persistent sandstone on Taylor run, in the southwestern corner of Gilmore township, Greene county, Pa., that has been named from this place by the writer[7] the **Taylor sandstone**. Like the Gilmore sandstone above, it forms steep bluffs and prominent escarpments around the hillsides in western Monongalia and Marion counties wherever the hills attain a height of over 1100 feet above the elevation of the Pittsburgh coal as shown by the contour lines on Map II. No quarries were observed on this ledge in either county. The sections for St. Cloud, Maple and Crossroads show its thickness and relative position to the other formations of the Dunkard measures.

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6. Ray V. Hennen, Marshall-Wetzel-Tyler Report, W. Va. Geol. Survey, page 173; 1909.
7. Ibid.

The **Middle Rockport limestone** was not observed in either county.

The Nineveh "A" Coal.

A new coal—2 to 3 inches thick—makes its appearance in the Dunkard series along the hill road on Brushy fork, 0.8 mile northeastward from St. Cloud in Battelle district. Its accurate position in the rock column at this place is exhibited in the St. Cloud section, page 92, where it is shown to come immediately over the Lower Rockport limestone, and 48 feet—hand-level measurement—above the undoubted Nineveh coal. Since this formation has never been noted or named, the writer has designated it the **Nineveh "A" coal** from its relation to the coal next below. This is the only point it was observed in either county. It is too thin to have any economic importance, but thick enough to be easily mistaken for the Nineveh bed below on account of its similar association with an underlying limestone.

The Lower Rockport Limestone.

At about 40 feet above the Nineveh limestone in the vicinity of Rockport in southern Wood county, there occurs 8 feet of dark gray limestone which has been designated from this place the **Lower Rockport**[8].

In western **Monongalia county** this stratum attains a fair development, and is often mistaken for the Nineveh limestone, 40 feet lower in the measures. The sections for St. Cloud and Maple, pages 92 and 168, respectively, exhibit its thickness, character and relative position to other formations of the Dunkard series, especially to the Nineveh coal. Along the southwestern border of Battelle district, it is this limestone that crops along the hill road on the head of North fork, 0.8 mile westward from the mouth of Whisler run, at an elevation of 1235′ A. T. by aneroid. Here the ledge is 5 feet thick, coming 40 feet above the Nineveh coal, and 1050 feet above the Pittsburgh bed. A sample for analysis was collected from

8. Ray V. Hennen, Wirt-Roane-Calhoun Rept., W. Va. Geol. Survey, p. 143; 1911.

the limestone at this place, the composition of which is reported by Messrs. Hite and Krak as follows, under Laboratory No. 599H:

	Per cent.
Silica (SiO_2)	26.17
Ferric Iron (Fe_2O_3)	2.82
Alumina (Al_2O_3)	6.22
Calcium Carbonate ($CaCO_3$)	57.60
Magnesium Carbonate ($MgCO_3$)	2.58
Phosphoric Acid (P_2O_5)	0.40
Loss on ignition	4.22
Total	100.01

One-half mile southward, this same ledge is exposed at crop in the hill in the rear of the residence of Bishop Whisler, coming there 40 feet by aneroid above an old digging in the Nineveh coal.

This limestone was not observed at any point in Marion county.

Although quite silicious in western Monongalia, it should, however, furnish a fair quality of road material.

The Nineveh Sandstone.

The next well known formation in descending order in the rock column is the **Nineveh sandstone,** which has been so named[9] from the village of Nineveh, Greene county, Pa., where it attains a good development at 5 to 20 feet above the Nineveh coal. It is yellowish gray and brown in color and furnishes only a fair quality of building stone owing to its sand grains being generally so loosely cemented that it crumbles on exposure to the weather.

In **Monongalia county** its relative position in the rock column is exhibited in the sections for St. Cloud and Maple, pages 92 and 168, respectively. It was once quarried for building purposes on the land of the White Heirs, on the south hillside of Brushy fork, 0.8 mile northeast of Maple. In this region it forms cliffs and prominent bluffs around the hills wherever the latter attain an elevation of 1025 feet and over above that of the Pittsburgh coal as shown by the contours on Map II.

9. I. C. White, Bull. 65, U. S. G. Survey, page 32; 1891.

In Marion county no quarries were observed on this ledge, but it is a conspicuous bluff former in the central and western portions of Mannington district.

The Nineveh Coal.

At 5 to 20 feet below the Nineveh sandstone there occurs a very persistent coal in the vicinity of Nineveh, Greene county, Pa., from which place it has been designated the Nineveh coal by J. J. Stevenson. In the area under discussion the crop of this coal is confined to the same area as given for the Nineveh sandstone. Its relative position in the rock column is accurately shown in the sections for St. Cloud and Maple, pages 92 and 168, respectively. The former shows it coming 291 feet below the Windy Gap coal, and 979 feet above the Pittsburgh vein, with a thickness of one foot. It is this bed that crops in the hill road, 0.1 mile southeast of the S. L. S. Spragg No. 1 well (4), 0.5 mile northeast of St. Cloud, Battelle district, at an elevation of 1216′ A. T. spirit level, where it is only 6½ inches thick with ½ inch of gray slate one inch below top. Here it comes 984 feet above the Pittsburgh coal as exhibited in the Spragg well (4).

Passing eastward to the hill road ¼ mile southeast of Maple, this coal is found cropping at an elevation of 1262′ A. T. spirit level (see Maple section), where it is 12 inches thick, coming 41 feet below the top of the Lower Rockport limestone, 86 feet above the Hostetter coal, and 252 feet above the Jollytown coal. Here the Nineveh-Hostetter coal interval is about 12 feet greater than that in the Burton section, as published by the writer on page 110 of the Marshall-Wetzel-Tyler report of the State Survey.

Three-tenths mile southwestward where this coal crops in the hill road on the head of Browns run, near the residence of William O. Hennen, it has a double-bedded structure, as follows:

			Ft.	In.
Shale				
Coal, slaty	0′ 3″	Nineveh coal (1265′B-A. T.)	4	3
Shale, gray	3 6			
Coal, slaty	0 6			
Shale, dark			0	4

Passing to the extreme southern border of Battelle district, it is found cropping at the foot of the hill road, 0.7 mile southward from St. Leo, at an elevation of 1205′ A. T. by aneroid. Here it is only 7 inches thick.

One mile and a half southeastward the coal is found cropping in the hill road on the head of Flat run, 1.6 miles west of Galletin, at an elevation of 1301′ L-A. T. Here it is only 5 inches thick and quite slaty.

The writer collected a sample of the Nineveh coal along the western margin of Battelle district where it crops along the hill road on the head of Camp run, 1.4 miles south about 10° east of St. Cloud. There the following section was measured:

	Ft.	In.
Sandstone		
Coal, Nineveh	1	0
Limestone, gray and hard, Nineveh	1	0
Concealed		

The composition and calorific value of this sample of coal as reported by Messrs. Hite and Krak, are found under **No. 1** in the table of coal analyses.

About 2 miles southward there occurs an old digging in this vein at an elevation of 1190′ B-A. T., just in the rear of the residence of Bishop Whisler, where it comes 40 feet below the Lower Rockport limestone, and 1015 feet above the Pittsburgh coal as exhibited in the Sol. Lemley No. 1 well (49), 0.3 mile northeastward.

With the exception of the exposure noted above on the head of Flat run, the Nineveh coal was not observed in Marion county. The coal is too thin and irregular in either county to have any economic importance, but it has been of great assistance in the correlation of the formations of the Dunkard series above the Fish Creek coal horizon.

The Nineveh Limestone.

The next well-known formation in descending order in the rock column is the **Nineveh limestone,** so designated[10]

10. I. C. White, Bull. 65, U. S. G. Survey, p. 32; 1891.

from the town of that name in Greene county, Pa. It usually comes 5 to 20 feet under the Nineveh coal.

In **Monongalia county** the crop of this limestone is well exposed in the northwestern corner of Battelle district, near the foot of the hill road on the head of Brushy fork. Here its thickness, character and relation to other formations of the Dunkard series, are exhibited in the St. Cloud section, page 92. The only other point in the county that its crop was observed was along the hill road leading southeast from Crossroads. Its relative position here to other well known formations of the Dunkard rocks is given in the Crossroads section, page 94.

In **Marion county** the only place that its crop was observed was in the railroad cut at the east portal of the Glover Gap tunnel. Its horizon, however, belongs in the hills over practically the same area as that outlined for the Nineveh sandstone.

It contains many minute fossils of apparently fresh water types.

The Burton Sandstone.

At 30 to 40 feet below the Nineveh coal in the vicinity of Burton, Wetzel county, there occurs a great massive sandstone, 30 to 40 feet thick, that has been named the **Burton**[11] **sandstone** from that place. Its crop in the area under discussion is confined to the western portions of Monongalia and Marion counties. Its thickness, character and relative position in the rock column are exhibited in the sections for Maple, Crossroads, and Daybrook in Monongalia, and for Whetstone Run and Fairview in Marion. It is this stratum that crops at the foot of the hill road near the S. L. S. Spragg No. 1 well (4), 0.6 mile northeast of St. Cloud, Battelle district, Monongalia county. It generally forms a prominent bluff along the hillsides of Dunkard creek and its tributaries eastward to the region of Blacksville. No quarries were observed on this ledge in either county.

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11. Ray V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Sur., p. 182; 1909.

The Hostetter Coal.

The Hostetter coal of White[12] belongs from a few inches to 5 feet below the base of the Burton sandstone, 75 to 90 feet below the Nineveh coal, 165 feet above the Jollytown coal, and 910 to 920 feet above the Pittsburgh bed. In the northwestern portion of Battelle district, Monongalia, this seam crops along the hill road, ¼ mile due east of Maple, at an elevation of 1176′ A. T. by spirit level. Here its thickness and relative position in the rock column are given in the section for the latter place, page 168. About 2.5 miles southwestward it crops a few inches thick along the road on Pone run, 0.6 mile above the mouth of the latter at an elevation of 1135′ B-A. T., coming about 70 feet below the Nineveh coal. The only other point its crop was observed was along the hill road near the low gap, 2 miles north 10°-15° west of Daybrook, where it is only 3 inches thick at an elevation of 1330′ A. T. by aneroid, coming about 180 feet above the Jollytown coal cropping 0.4 mile northeastward on Kings run near the Sol Meyers wells. The coal is too thin to have any economic value.

The Fish Creek Sandstone.

At 40 to 50 feet below the Hostetter coal in the region of Littleton, Wetzel county, there occurs a very massive sandstone that has been named by J. J. Stevenson the **Fish Creek**[13] from its outcrop on a stream of that designation in the southwestern corner of Greene county, Pa. In the area under discussion, its thickness, character and relative position in the rock column are exhibited in the sections for Crossroads, Mooresville and Daybrook. It comes immediately over the Fish Creek coal, and its crop is confined to the western portions of Monongalia and Marion counties. It generally makes a steep bluff around the hillsides about 100 feet above the crop of the Jollytown coal. In the northwestern portion of Battelle district, it is this stratum that crops in the road near the old

12. I. C. White, Bull. 65, U. S. G. Sur.; p. 33; 1891.
13. Ray V. Hennen, Marshall-Wetzel-Tyler Rept.; W. Va. Geol. Sur., p. 185; 1909.

Wm. H. Hennen residence, one-fifth mile southwest of the Eli White No. 1 well (5), where it comes about 820 feet above the Pittsburgh coal. No quarries were observed on this ledge in either county.

The Fish Creek Coal.

Immediately at the base of the Fish Creek sandstone in the vicinity of Littleton, Wetzel county, there occurs a double-bedded coal, 10 to 18 inches thick, coming 65 feet above the Dunkard coal, and 116 feet above the Jollytown bed, that has been designated the **Fish Creek**[14] from its association with the overlying sandstone. In the area under discussion its thickness and relative position in the rock column are exhibited in the sections for Crossroads, Mooresville and Behler.

The crop of this coal was not observed at any point in Marion county.

In Monongalia, however, it was noted at several places in Battelle and Clay districts. Its slaty blossom shows at the upper edge of the public road, 200 to 300 yards southward from the Hennen school house and 1.7 miles northeast of St. Cloud, at an elevation of 1095′ A. T. by aneroid. Southeastward on Shriver run and 1.2 miles due north of Wadestown, its crop is exposed flush with the top of the Geo. Shriver No. 1 well (29), in which the top of the Pittsburgh coal was struck at a depth of 866 feet, giving an accurate measurement for the interval between the two coals. Its crop is also exposed along the road leading up Miller run near the mouth of the latter stream, 1.4 miles west of Wadestown, at an elevation of 1065′ A. T. by aneroid. Here it is only 3 inches thick. Passing southeastward 2 miles to the public road on Range run, 1.7 miles due south of Wadestown, this coal—6 inches thick—is found cropping 15 feet above the mouth of the M. J. Garrison No. 2 well (94) at an elevation of 1070′ A. T. by aneroid. Its interval above the Pittsburgh coal has thickened here to about 900 feet.

In Clay district it crops along the hill road southeast of

14. R. V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Sur., p. 187; 1909.

Mooresville at an elevation of 1380′ A. T. by aneroid, having there a thickness of only 3 to 4 inches. About the same thickness of this coal is exposed at Behler at an elevation of 1385′ A. T. by spirit level. The bed is too thin and irregular to have any economic importance.

The Fish Creek Fire Clay Shale.

Immediately under the Fish Creek coal there nearly always occurs a fire clay shale, ranging in thickness from 5 to 8 feet, which resembles very much in character and texture the Washington fire clay shale as described on page 163 of the Wirt-Roane-Calhoun report of the State Survey. The writer has designated it the Fish Creek fire clay shale on account of its association with the overlying coal. Its thickness and relative position in the rock column are exhibited in the sections for Crossroads, Maple and Fairview. It is a great aid in correlating the Dunkard formations immediately above and below. No sample was collected for analysis, but, like the Washington fire clay shale, it would probably burn into a fair quality of building and paving brick.

The Rush Run Sandstone.

At 30 to 40 feet below the Fish Creek coal and immediately over the Dunkard coal on Rush run, near Hundred, Wetzel county, there occurs a massive sandstone, ranging from 10 to 25 feet in thickness, that has been designated from the latter stream the **Rush Run**[15] **sandstone.** It resembles very much in character and structure the Fish Creek sandstone above, and was formerly correlated with this ledge by Messrs. White and Stevenson. However, the writer in the reference given in the foot-note shows its true position in the measures. Its crop is confined to the western portions of Monongalia and Marion counties. Its thickness, character and relative position in the rock column in the area under discussion are exhibited in the sections for Crossroads, Whet-

15. R. V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Survey, p. 191; 1909.

stone Run and Metz. It generally forms a steep bluff around the hillsides 15 to 50 feet above the crop of the Jollytown coal. This ledge was once quarried for building purposes by Michael White near the bed of Dunkard creek, one mile northwest of Maple, where it is medium coarse, gray, micaceous and 15 to 20 feet thick, coming 3 feet above one foot of Dunkard coal in the bed of the creek. It is this stratum that crops in the road at the south end of the highway bridge over the latter stream, one-fourth mile westward.

The Dunkard Coal.

At 1 to 10 feet below the base of the Rush Run sandstone near the last mentioned locality, there occurs a double-bedded coal, ranging in thickness from 5 to 15 inches, that has been designated by J. J. Stevenson the **Dunkard coal** from the creek at this place. This coal was formerly placed at the base of the Fish Creek sandstone by Messrs. White & Stevenson, but on pages 187-193 of the Marshall-Wetzel-Tyler Report, the writer shows that the coal at the base of the latter sandstone represents a separate and distinct bed. Its thickness and relative position in the rock column in the area under discussion are exhibited in the sections for Maple, Crossroads and Daybrook in Monongalia, and for Whetstone Run and Fairview in Marion.

In Monongalia it crops in the bed of Dunkard creek, one mile northwest of Maple, on the Fred H. Hennen farm, at an elevation of 1055′ A. T. by aneroid. Here it is only 1 foot thick, coming 790 to 800 feet above the Pittsburgh coal, according to the log of the F. H. Hennen well (6), 0.2 mile southward.

One mile southeastward it crops in the bed of Brushy fork, on the land of Levi White, 200 to 300 feet west of the Thos. White No. 1 well (10), flush with the top of the latter, giving an accurate measurement of the Dunkard-Pittsburgh coal interval as 785 feet. (See section for Maple, page 168). Here the Dunkard is 12 inches thick, coming 52 feet by hand-level below the Fish Creek coal horizon, 120 feet below the Hostetter bed, and 206 feet below the Nineveh seam. The

writer collected a sample for analysis at this place, the composition and calorific value of which as reported by Messrs. Hite and Krak are found under No. 2 in the table of coal anaiyses.

On the north bank of Brushy fork, 150 to 250 feet northeast of the Thos. White well (10), this coal was once mined for blacksmith purposes, but the opening had fallen shut when visited by the writer in 1911.

One mile northeast of Maple its crop is exposed along the road leading southeast from Brushy fork to the head of Pumpkin run at an elevation of 1080′ A. T. by aneroid. Here the rock succession below to the Jollytown bed is included in the Maple section, page 168.

About 3½ miles southeastward on Range run road, 0.6 mile southeast of Wadestown, the Dunkard coal crops at an elevation of 1040′ A. T. by spirit level, where the following section is exposed:

	Ft.	In.
Concealed	..	..
Shale	1	0
Coal, Dunkard	0	6
Fire clay	2	0
Sandstone, limy	5	0

The Dunkard-Pittsburgh coal interval has thickened up southward here to 851 feet as determined from the log of the Lewis Wilson No. 1 well (32), located about 500 feet northeastward. Passing eastward to the hill road leading southeastward from the village of Crossroads, this coal is found cropping at an elevation of 1120′ A. T. (See Crossroads section, page 94). Here it is double-bedded, 12 inches thick, carrying 5 inches of gray shale 6 inches above bottom, and coming 46.7 feet below the Fish Creek coal, 62 feet above the Jollytown coal, and 841 feet above the Pittsburgh bed.

In **Marion county** the crop of the Dunkard coal was observed at a number of places. Along the northern boundary of Mannington district its blossom is exposed in the public road near the head of Flat run, 200 to 300 feet north of the Frank Thomas No. 1 well (423), at an elevation of 1145′ A. T., 60 feet above an old opening in the Jollytown bed a short distance southeastward.

Mr. Reger reports the blossom of a coal along the pub-

lic road, ¾ mile southeast of Glover Gap at an elevation of 1060′ A. T. aneroid, and ½ mile northeastward from the latter place along the road on Big run at an elevation of 1070′ A. T. aneroid, that should correlate with the Dunkard bed, coming as it does about 825 feet above the Pittsburgh coal.

The following section was measured at the crop of this coal along the hill road leading west from Flat run, 1.1 miles northeast of Metz, where it crops at an elevation of 1165′ A. T. aneroid:

	Ft.	In.
Coal	0	1
Shale, gray	0	0½
Coal	0	5
	0	6½

These are the only places the bed was recognized in Marion county.

The coal is too thin and irregular to have any economic importance.

The Jollytown Sandstone.

In the 50 to 60 feet of measures that intervene between the Dunkard coal and the Jollytown vein next below, there frequently occurs a massive sandstone that has been named the **Jollytown**[16] on account of its association with the coal next below. At the type locality of the Jollytown coal on Dunkard creek at Jollytown, Greene county, Pa., and 2 miles westward therefrom, near the residence of J. P. Hagan, this stratum attains a fair development. In the area under discussion, its thickness, character and relative position in the rock column are exhibited in the sections for Maple, Crossroads, Daybrook, and Mooresville, in Monongalia county; and for Metz and Whetstone run, in Marion. Its crop is confined to the western portions of both counties. It generally forms a prominent bluff or escarpment around the hillsides wherever it comes above drainage. It is this stratum that forms the great cliffs and strews the ground with large

16. R. V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Survey, p. 196; 1909.

boulders on the waters of Days run, 1 mile north and ¾ mile northeast of Daybrook at an elevation of 1170′ and 1200′ A. T., aneroid, respectively, coming there 195 feet above the Pittsburgh coal, or just above the horizon of the Jollytown coal, the latter being concealed at both places. Here the sandstone is massive, coarse, brown, hard, and 35 to 40 feet thick. No quarries were observed on this ledge, yet, at the place last mentioned it should furnish a fair quality of building stone.

The Jollytown Limestone.

At 25 to 30 feet below the Dunkard coal in the vicinity of Jollytown, Greene county, Pa., there occurs a limestone, 1 to 2 feet thick, that has been named from that place the **Jollytown**[17]. The crop of this limestone was recognized at only one place in the Monongalia-Marion-Taylor area. This was along the eastern border of Battelle district, Monongalia, at the south edge of the public road, on the land of Alfred Talkington, 1.7 miles north 82° east of Crossroads, where the following section was measured, about 190 feet above the Pittsburgh coal:

	Ft.	In.
Slate, black	0	8
Shale, gray	0	10
Limestone, dark gray and hard, Jollytown	1	6
Shale and concealed	6	0
Coal, Jollytown, 18″ to (1085′ B.A. T.)	2	0
Fire clay and limy shale	4	0
Limestone, buff, silicious, Upper Washington	3	0
Concealed		

A sample for analysis was collected here from the Jollytown limestone, the composition of which is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	5.57
Ferric Iron (Fe_2O_3)	3.64
Alumina (Al_2O_3)	2.31
Calcium Carbonate ($CaCO_3$)	83.94
Magnesium Carbonate ($MgCO_3$)	1.95
Phosphoric Acid (P_2O_5)	0.26
Loss on ignition	2.10
Total	99.77

17. I. C. White, Bull. No. 65, U. S. G. Survey, page 34; 1891.

The results show this ledge fairly pure and a much better limestone than the Lower Rockport above.

The Jollytown Coal.

At 45 to 60 feet below the Dunkard coal and directly above the Upper Washington limestone there occurs a persistent, double-bedded coal which has been designated by J. J. Stevenson the Jollytown from its crop near the village of that name in Greene county, Pa. On pages 197 and 198 of the Marshall-Wetzel-Tyler Report of the State Survey, the writer gave a section of the bed at its type locality along with a complete analysis of the same and its calorific value.

In the area under discussion the crop of this coal is confined to the western portions of Monongalia and Marion counties. Its interval above the top of the Pittsburgh bed increases both south and east, as will appear from the following table:

Table Showing Jollytown-Pittsburgh Coal Interval.

Map No.	Name of Well.	Location.	Feet.
	(Monongalia County)		
13	J. P. Hagan No. 1....	Jollytown, 2 miles west of.....	731
14	Hagan Taylor No. 1...	Jollytown, 1.5 miles west of.....	728
10	Thos. White No. 1....	Jollytown, 2 miles southwest of...	739
21	Elza Wade No. 2348...	Jollytown, 0.8 mile southeast of..	750
24	Jas. Hagan No. 1.....	Wise, 0.6 mile southwest of.....	763
63	Eb. Bell No. 4.....	Bula, 0.9 mile west of.....	778
81	Elihu Eddy Heirs No. 6.	Crossroads	785
110	Anna Harvey No. 1...	Galletin, 1.3 miles northeast.....	790
148	Sol. Meyers No. 1.....	Blacksville, 1.3 miles S 10° W of.	796
163	John Henderson Heirs	Daybrook, 0.3 mile southeast of...	810
162	Marion Tennant No. 1.	Daybrook, 1.1 miles southwest of.	805
	(Marion County)		
398	Aaron Furbee No. 1...	Glover Gap, 1.2 miles southeast of.	777
380	M. M. Kendall No. 135.	Seven Pines, 1.4 miles east of....	781
450	A. J. Hayes No. 15....	Rymer, 0.8 mile northeast.....	778
516	Michael Kennedy No. 1.	Mannington, 3 miles southwest of.	787

The gradual increase of this interval south and east, as exhibited by the above table, is due in a large measure to thickening up in these directions of the intervening Monongahela series.

In the area under discussion, the thickness, character and relative position of this coal in the rock column are shown in the sections for Maple, Crossroads, Daybrook and Behler for Monongalia county; and for Metz and Whetstone Run in Marion.

In **Monongalia county** the Jollytown, next to the Washington, is the most persistent coal of the Dunkard series, where it frequently attains a thickness of two feet. On the northern edge of Battelle district it is this coal that crops 5 to 10 feet above the level of Brushy fork, 200 to 300 feet south of the Hagan Taylor No. 1 gas well (14), where the following section was measured:

	Ft.	In.
Sandstone, shaly, Jollytown	8	0
Shale	5	0
Concealed	3	0
Coal, Jollytown	1	0
Fire clay	1	0
Limestone, Upper Washington	2	6
Concealed to Brushy fork level	10	0

As shown by the last table given, it comes 728 feet above the Pittsburgh coal, and, according to the log of the J. P. Hagan No. 2 well (12), 403 feet above the Waynesburg coal.

The following section was measured at its crop along the public road, 0.6 mile southwest of Wise (Wana), near the Jas. Hagan No. 1 well (24), the base of the coal coming 46 feet by hand-level above the well mouth:

		Ft.	In.
Shale		..	..
Coal ....0′ 11″			
Shale, gray..0 0½	Jollytown coal	1	5½
Coal 0 5			
Slate, black		0	3
Fire clay		1	0
Limestone, silicious, Upper Washington		1	0
Concealed		..	..

Elevation of coal, 1040′ B-A. T.; Jollytown-Pittsburgh coal interval, 763 feet.

About three miles southward, this bed was once mined on the land of A. J. Corrothers at Crossroads for local domestic fuel and smithing purposes. The writer collected a sample for analysis from the upper bench of this seam (See Crossroads section, page 94) at its crop in the road on the east

edge of the town, the composition and calorific value of which as reported by Messrs. Hite and Krak are found under No. 3 in the table of coal analyses.

In Clay district the Jollytown coal has been mined quite frequently by farmers for domestic fuel. It is this bed that has been mined by stripping from the run bed at the road fork, 1.4 miles northward from Daybrook and 0.3 mile southeast of the Asa Lemley No. 2 oil well (152), where it has an elevation of 1155′ A. T., aneroid. It has also been mined on the east hillside at Daybrook at an elevation of 1195′ A. T., aneroid, on the land of Azariah Wilson, coming there about 810′ above the Pittsburgh bed. The opening had fallen shut in 1911, so that its thickness could not be measured, but it is reported as being 18 to 24 inches thick, and a fair quality of coal.

An opening occurs in this bed 1¼ miles westward from Daybrook along the south edge of the public road near the Marion Tennant No. 1 well (162), where, according to the log of the latter, the coal comes 805 feet above the Pittsburgh vein. The following section was measured at this mine:

	Ft.	In.
Sandstone, massive, Jollytown	35	0
Coal, Jollytown	1	4
Shale, gray, many fossil plants	0	6
Concealed to M. Tennant No. 1 well (162)	9	6

In **Marion county** the Jollytown coal crops southwestward entirely across the central and eastern portions of Mannington district. The section for Metz exhibits its thickness and double-bedded nature in that locality. Two miles northeastward on Flat run, near the Frank Thomas No. 1 well (423), it was once mined at the east edge of the road at an elevation of 1085′ A. T., aneroid, 60 feet below the blossom of the Dunkard seam in the road bend to the northeast. The opening had fallen shut so that it was not possible to measure the bed.

Passing southwestward to near the foot of the hill road on the head of Hibbs run, 1 mile southwest of Metz, Mr. Reger reports the blossom of this coal at an elevation of

1120′ A. T., aneroid, and at 1105′ A. T. aneroid, ¾ mile westward along the Rex run road.

Mr. Reger also reports the blossom of this bed along the road on Buffalo creek at the east edge of Rymer at an elevation of 1055′ A. T., and also 0.8 mile northeastward from the latter place along the road on Bartholomew fork, near the A. J. Hayes No. 15 well (450), at an elevation of 1070′ A. T., aneroid, coming, according to the log of this boring, 178 feet above the Pittsburgh coal.

Southwestward on the waters of Owen Davy fork, according to Mr. Reger, its blossom shows in the road, 0.5 mile south 50° west, of Curtisville at an elevation of 1045′ A. T., aneroid; and also in the road on Camp run, 0.7 mile southwest of Curtisville, at an elevation of 1065′ A. T., aneroid. He also reports it thin and unimportant in the southern portion of Mannington district. The Whetstone Run section, page 127, gives only 9 inches of slaty coal at this horizon, 49 feet below 3 inches of Dunkard coal, 236 feet above the Washington seam, and 187 feet above the Pittsburgh vein.

In eastern Battelle and western Clay districts, Monongalia county, and in the northwestern portion of Mannington district, Marion, the Jollytown coal may sometime furnish a large tonnage of fairly pure coal, but it is too thin and irregular to compete at this time with the thicker and better coals in the Monongahela series in the same locality. However, it is a very important key rock in correlating the upper Dunkard formations, and for that reason it is of much scientific interest.

The Upper Washington Limestone.

The Upper Washington limestone of J. J. Stevenson[18] comes from 1 to 5 feet under the Jollytown coal in the region of Jollytown, Greene county, Pa., where it ranges from 1 to 4 feet thick. Where this ledge crops along the public road on Brushy fork in the northern edge of Battelle district, Monongalia, one mile northeast of Maple, it is gray, hard, silicious

18. J. J. Stevenson, Sec. Geol. Survey of Pa., Vol. K, p. 45; 1875.

and 2½ feet thick, coming only 1 foot below the Jollytown coal and 125 feet above the Pittsburgh coal.

Passing 6 miles southeastward to a point in the public road 1.7 miles north 82° east of Crossroads, 3 feet of this ledge is found exposed 4 feet below the Jollytown coal, as exhibited in the section for this point given on page 94, under the discussion of the "Jollytown Limestone." A sample for analysis was collected here, the composition of which is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	68.00
Ferric Iron (Fe_2O_3)	5.51
Alumina (Al_2O_3)	13.31
Lime (Ca O)	3.02
Magnesia (Mg O)	1.36
Sodium (Na_2O)	1.32
Potassium (K_2O)	1.53
Titanium (TiO_2)	0.28
Phosphoric Acid (P_2O_5)	0.16
Moisture	0.28
Loss on ignition	4.40
Total	99.17

The analysis shows that there is but little lime in the formation at this point.

In the southeastern corner of Battelle district its crop is exposed along the road on Harvey run at the Anna Harvey No. 1 well (110), where the following section was measured:

	Ft.	In.
Sandstone, flaggy, Jollytown	15	0
Shale, sandy	5	0
Black slate...0′ 6″ / Coal .....0 2 } Jollytown coal	0	8
Fire clay	1	0
Limestone, gray, hard, silicious, Upper Washington	3	0
Shale and concealed to top Anna Harvey No. 1 well (110)	6	0
Interval in well to Pittsburgh coal	780	0

In the northwestern corner of Clay district, Monongalia, this ledge has become largely a limy sandstone where its crop is exposed on the Thomas run road, 2½ miles southwest of Blacksville, as exhibited by the Daybrook section, page 169.

One mile and a half southward and 1.2 miles westward

from Daybrook, the following section was measured at the crop of this limestone along the public road:

		Ft.	In.
Sandstone, massive, Jollytown		40	0
Shale		0	4
Coal ....0′ 11″			
Shale, gray..0 0½	Jollytown coal	1	1½
Coal, slaty..0 2			
Fire clay		1	0
Limestone, very silicious, Upper Washington		1	0

In **Marion county** the Upper Washington limestone appears to be quite generally absent from the measures. Although its horizon is exposed, it was not observed in the Metz and Whetstone Run sections. It is a very important formation in helping to identify the overlying coal, but owing to its very silicious character it is not of much economic value.

The Hundred Sandstone.

At 5 to 10 feet under the Upper Washington limestone and about 200 feet above the Washington coal, a massive, bluish and brown sandstone, ranging in thickness from 30 to 40 feet, has been quarried quite extensively for building purposes a short distance west of Hundred, Wetzel county, from which place it has been named the **Hundred**[19] **sandstone.** In the area under discussion it is quite a prominent cliff former in northeastern Battelle and northwestern Clay districts, Monongalia county. It is this stratum that forms the cliffs along the public road on West Virginia fork of Dunkard, one mile northeast of Wise (Wana), where its base comes at an elevation of 975′ A. T., aneroid, 75 feet below an opening in the Jollytown coal, 0.2 mile northwestward. It is this sandstone that forms the bed of Garrison fork at the bridge over same 0.4 mile west of Jollytown, Pa. It also forms the bed of Pennsylvania fork of Dunkard at Hero, Pa., just across the Mason-Dixon line from Battelle district.

Passing on down Dunkard creek into Pennsylvania at

19. Ray V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geo. Survey, p. 214; 1909.

the northern point of a loop of Dunkard creek to the north, 0.6 mile northeast of the mouth of Hoovers run, the following aneroid section was measured at the crop of this sandstone in a ravine:

	Ft.	In.
Sandstone, massive, Jollytown	30	0
Coal, Jollytown, 12" to (1065' B-A. T.)	1	6
Fire clay shale	3	0
Limestone, silicious, Upper Washington	2	0
Shale	10	0
Sandstone, massive, Hundred	45	0
Fire clay shale	15	0
Concealed to Dunkard creek level	50	0

In the northwestern corner of Clay district, Monongalia, this ledge crops in a cliff on the north bank of Miracle run, opposite the residence of R. S. Thomas, 0.6 mile northeast of Bula. Here it has been quarried for building purposes, furnishing the stone for the steps and foundation of the residence of R. S. Thomas who reports it highly satisfactory. At this quarry a portion of it is quite flaggy and furnishes a fine quality of flagstone. Its base comes at an elevation of 1000' A. T., aneroid, 672 feet above the top of the Pittsburgh coal, according to the log of the R. S. Thomas No. 1 well (131) near by.

In Marion county the Hundred sandstone generally forms a steep bluff around the hillsides, 8 to 10 feet below the Jollytown coal, wherever the latter bed crops 75 to 100 feet above drainage. The Whetstone Run section, page 127, shows this stratum, including 4 feet of shale, to be 49 feet thick, 9 feet below the Jollytown coal, 174 feet above the Washington coal, and 729 feet above the Pittsburgh coal. No quarries were observed on this ledge in Marion county.

The Hundred Coal.

At the type locality of the sandstone last described there occurs a thin coal, 3 to 4 inches thick, 2 to 5 feet below this sandstone, that has been named the **Hundred** [20] **coal** from the town of Hundred, Wetzel county. Its relative position in the rock column is exhibited in the section for Metz, page 170.

20. Ray V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va., Geol. Survey, p. 215; 1909.

In **Monongalia county** coal was observed on the crop of this horizon at only one locality. This was in the northeastern edge of Battelle district where it crops along the public road on Left branch of Miracle run, 0.5 mile south of Bula, at an elevation of 975′ A. T., aneroid. Here the following section was measured:

	Ft.	In.
Sandstone, Hundred	..	..
Shale, sandy	6	0
Coal, slaty, Hundred	0	2
Fire clay and shale	5	0

The coal comes about 700 feet above the Pittsburgh bed.

In **Marion county** the blossom of this coal shows along the public road on Johnnycake run, 0.3 mile northeast of Metz, at an elevation of 1025′ A. T., aneroid, coming 55 feet below the Jollytown coal and about 720 feet above the Pittsburgh bed.

About 5 miles southwestward, near the mouth of Bartholomew fork, Mr. Reger reports the blossom of a coal at the edge of the public road, at an elevation of 1020′ A. T., aneroid, that appears to correlate with the Hundred vein, coming as it does about 685 feet above the Pittsburgh bed. He also reports the blossom of a coal that seems to come at this horizon 1 mile north 5°—10° east of Logansport, along the road on Long drain.

The coal is too thin and irregular to have any economic value.

The Upper Marietta Sandstone.

The interval between the Hundred and Washington coals is often occupied by two sandstone ledges, each 30 to 50 feet thick that were designated by I. C. White[21] the **Marietta sandstones** from their occurrence near Marietta, Ohio, where they have long been quarried for grindstones. These have been further designated the **Upper** and **Lower**[22] **Marietta** sandstones. Their relative position in the Dunkard series is ex-

21. Bull. 65, U. S. G. Survey, page 35-36; 1891.

22. Ray V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Survey, p. 215; 1909.

hibited in the general section of the latter series at the beginning of this chapter.

In the Monongalia-Marion-Taylor area the crop of the Upper Marietta sandstone is confined to the central and western portions of Monongalia and Marion. Its thickness, character and position in the rock column therein are shown by the sections for Mooresville, Mannington and Fairview. It generally forms a steep bluff around the hillsides about 100 feet above the level of the crop of the Washington coal. No quarries were observed on this ledge in either county.

The Washington "A" Coal.

At the base of the Upper Marietta sandstone and 80 to 100 feet above the Washington coal there occurs an impure coal and coaly shale along Dunkard creek, Monongalia county, in the Blacksville region, that has been designated the **Washington "A"**[23] coal from its association with the coal next below. Its crop is confined to a belt southwestward across the central portions of Monongalia and Marion counties.

In **Monongalia county** the crop of this coal is exposed along the public road in the northern edge of Clay district, 0.3 mile due west of Blacksville at an elevation of 980′ A. T., aneroid, where the following section was measured:

			Ft.	In.
Sandstone, massive, Upper Marietta			50	0
Shale, concealed and shale			6	0
Coal, slaty	0′ 3″			
Slate, black	0 4			
Shale, gray, with black slaty streaks	1 8	Washington "A" Coal	2	8
Coal, slaty	0 5			
Fire clay			..	..

Here it comes 600 to 615 feet above the Pittsburgh coal as shown by the records of gas wells in the vicinity.

Passing eastward 2.5 miles to the road on Rudolph run, the following section is exposed near the E. C. Henkins No. 1 well (142), the coal coming at an elevation of 960′ A. T.,

23. I. C. White, Bulletin 65, U. S. G. Survey, page 35; 1891.

aneroid, 615 feet above the Pittsburgh bed, according to the log of the Henkins well (142):

		Ft.	In.
Sandstone, massive, Upper Marietta		10	0
Shale		3	0
Slate, black		1	3
Coal, slaty	0′ 4″		
Shale, gray	2 0	Washington "A" coal	2 10
Coal, slaty	0 6		

Southwestward on Days run, the Washington "A" coal crops along the road, 0.6 miles southwest of the mouth of the latter stream, at an elevation of 955′ A. T., aneroid. Passing up Days run to the road fork, 0.7 mile northeast of Daybrook, it occurs on the land of Jesse Headley, at an elevation of 1000′ A. T., aneroid, where the following section is exposed:

		Ft.	In.
Shale, sandy		10	0
Coal, slaty	0′ 4″		
Slate, black and limy, hard	0 3	Washington "A" coal	2 4
Slate, black	0 3		
Slate, gray	1 2		
Coal, slaty	0 4		
Fire clay			

At Daybrook the blossom of this coal shows on the east bank of Days run at an elevation of 1013′ A. T., spirit level, coming about 110 feet below an old opening in the Jollytown bed. One mile and a half due south of Daybrook, it is this coal that shows along the road, 200 yards southward from the residence of Stephen Mason, at an elevation of 1085′ A. T., where only 6 inches of coal is visible.

In **Marion county** the Washington "A" coal appears to be quite generally absent from the measures, since it was not recognized therein at any point. Even in Monongalia this coal is too thin, slaty and impure to be considered of economic value.

The Creston Red Shale.

In the interval separating the Upper and Lower Marietta sandstones there generally occurs 20 to 60 feet of dark red shales that have been designated[24] from their fine develop-

24. Ray V. Hennen, Wirt-Roane-Calhoun Rept., W. Va. Geol. Survey, p. 154; 1911.

ment on the "Creston Flats" near the town of Creston in Wirt county. Its thickness and relative position in the rock column are exhibited in the sections for Mannington and Whetstone Run, pages 126 and 127 respectively. While not so well developed here as in Wirt, Roane and Calhoun counties, yet its crop around the hillsides of Clay and Grant districts, Monongalia county, and Pawpaw, Lincoln and Mannington districts, Marion, generally forms a gentle slope or distinct break or bench in the topography. Sometimes these reds are largely replaced by sandy beds.

The **Middle Washington limestone** of Stevenson[25], belonging near the base of the Creston red shale, was not recognized in this area. However, it may have been inadvertently overlooked, but if present, it must be in poor development not to attract attention.

The Lower Marietta Sandstone.

Referring to the discussion of the Marietta sandstones in the account given for the Upper Marietta sandstone, page 195, the lower ledge has been designated the Lower Marietta[26]. At its type locality this stratum comes about 5 feet above the Washington coal, and 62 feet below the Upper Marietta sandstone.

In the Monongalia-Marion-Taylor area the crop of this formation is practically the same as that outlined for the Washington coal on Map II. Its thickness and relative position in the series are given in the sections at Mooresville for Monongalia, and on Whetstone Run in Marion county. Like the Upper Marietta ledge it frequently forms a steep bluff around the hillsides. No quarries were observed on this stratum in either county, although it furnishes a fine quality of building stone near Spencer in Roane[27].

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25. J. J. Stevenson, Sec. Geol. Survey of Pa., Vol. K, p. 49; 1875.

26. Ray V. Hennen, Marshall-Wetzel-Tyler Rept., W. Va. Geol. Survey, p. 217; 1909.

27. Ray V. Hennen, Wirt-Roane-Calhoun Rept., W. Va. Geol, Sur.; p. 155; 1911.

The Washington "Rider" Coal.

In Monongalia and Marion counties an impure, thin and slaty coal most generally occurs directly above the Lower Washington limestone, and about 10 feet above the Washington coal. The writer has designated it the **Washington "Rider" coal** on account of its close association with the former bed, and in contradistinction to the Washington "A" vein for which it is frequently mistaken. The following section, measured near the head of Statler run at the north portal of an abandoned railroad tunnel, about a mile and a half northwest of Center (McCurdyville), exhibits its true position in the rock column:

		Ft.	In.
Shale, sandy		7	0
Slate, bituminous 1′ 3″ Coal, bony 0 4	Washington "Rider"	1	7
Limestone, gray and hard 1′ 0″ Shale, limy, gray 2 0 Limestone, gray and hard 1 0 Shale, gray and limy 1 6 Limestone, gray and hard 1 3	Lower Washington Limestone	6	9
Shale, gray		3	0
Coal, slaty 1′ 6″ Slate, black 0 4 Coal, good 0 10	Washington coal (1150′ B-A. T.)	2	8
Slate, dark and gray		4	0
Sandstone, flaggy, Washington, to floor of cut for tunnel		5	0

The base of the section comes about 540 feet above the Pittsburgh coal.

One mile due westward the following section was measured at the crop of the Washington "Rider" coal in the public road, 0.2 mile northeast of Sandy, where it comes 512 feet above the Pittsburgh coal according to the log of the Presley Tennant No. 1 well (195) close by:

		Ft.	In.
Sandstone, flaggy		5	0
Shale, sandy		5	0
Coal, slaty 0′ 1″ Shale, gray 1 0 Coal, slaty 0 2 Shale gray 0 6 Limestone, silicious 0 4 Shale, gray 0 10 Black, coaly slate 1 6 Coal 0 3	Washington "Rider" coal	4	8

	Ft.	In.
Limestone, gray and hard, Lower Washington	2	0
Coal, Washington	2	0
Shale, gray	0	6
Sandstone, Washington	2	0

In **Marion county** the only locality the Washington "Rider" coal was observed was where its crop is exposed along the public road in the last mile of the lower course of Flat run, 2 miles northward from Mannington. Here 3 feet of black slate interlaminated with coal crops at an elevation of 985′ A. T., directly over the Lower Washington limestone, and 520 to 530 feet above the Pittsburgh coal.

Like the Washington "A" coal, 80 to 90 feet above, this bed is too thin, slaty and impure ever to be mined successfully.

The Lower Washington Limestone.

The Lower Washington limestone of Stevenson[28] comes immediately above the Washington coal, and 225 to 250 feet below the Upper Washington limestone. Its thickness, character and relative position in the rock column in Clay district, Monongalia, are exhibited in the sections given on pages 199 and 200 in connection with the Washington "Rider" coal.

In the northern portion of the district, this limestone with its shale layers is about 4 feet thick where its crop is exposed along the public road, 0.5 mile northwest of Mooresville. Here its top comes 67 feet by hand-level below the top of the D. C. Core No. 1 well (170) in which the top of the Pittsburgh coal was struck at a depth of 624 feet, placing the limestone 553 feet above the latter coal.

A sample for analysis was collected from this ledge, the composition of which is reported by Messrs. Hite and Krak as follows under Laboratory No. 616H:

	Per cent.
Silica (SiO_2)	17.55
Ferric Iron (Fe_2O_3)	2.61
Alumina (Al_2O_3)	1.42
Calcium Carbonate ($CaCO_3$)	72.62
Magnesium Carbonate ($MgCO_3$)	2.16
Phosphoric Acid (P_2O_5)	1.17
Loss on ignition	1.50
Total	99.03

28. J. J. Stevenson, Sec. Geol. Survey of Pa., Vol. K, p. 45; 1875.

It attains a fine development on Doll run, 0.4 mile northwest of Core as appears in the Kate Core Mine section, given on a subsequent page in the description of the Washington coal.

In **Marion county** the crop of the Lower Washington limestone was recognized at only one locality. This was along the last mile of the lower course of Flat run, 2 miles northward from Mannington, where the following section was measured:

	Ft.	In.
Sandstone, shaly, Lower Marietta	10	0
Shale, sandy	10	0
Black slate with streaks of coal, Washington "Rider"	3	0
Limestone, gray and hard 1′ 6″ / Shale, gray and limy 1 3 / Limestone, gray and hard 1 6 — Lower Washington Limestone (985′ B-A. T.)	4	3
Shale, dark gray, with limestone nuggets at top	7	0
Sandstone, massive	1	0
Shale, dark	1	0
Coal 0′ 5″ / Black slate 3 0 / Concealed to Flat run 3 0 — Washington coal	6	5

The section is almost typical of that at this horizon as found at the north portal of the abandoned tunnel, as given under the account of the Washington "Rider" coal on a preceding page.

The limestone is quite hard and appears to possess fair cementing properties, and for that reason would make road material, although limited in quantity.

The Washington Coal.

At 1 to 5 feet under the Lower Washington limestone there occurs a multiple bedded coal seam with the purest coal in its basal portion, that has been designated the **Washington coal** by White and Stevenson from its fine development near Washington, Pa. Previously, however, it had been called the Brownsville coal by White[29] from a village of that name in Monongalia county, West Virginia, near which it had been mined by farmers for local domestic fuel and smithing purposes.

29. I. C. White, Bull. No. 65, U. S. G. Survey, p. 37; 1891.

In Monongalia and Marion counties it is by far the most important coal from an economic standpoint in the Dunkard series. Its crop therein is outlined in detail on Map II, and as thereon exhibited is confined to a belt about 10 miles wide southwestward entirely across both counties.

Monongalia County.—In Monongalia the thickness and relative position of the Washington coal to other formations of the Dunkard series are exhibited in the sections for Mooresville and Behler, pages 96 and 97 respectively.

Passing down the Dunkard creek road to Pentress, this coal first makes its appearance above drainage on the east side of the creek where its blossom shows at an elevation of 938′ A. T., spirit level. Three-fourths mile southeastward this vein was once mined on the south bank of Dunkard opposite Worley (Browns Mills), at an elevation of 986′ A. T., spirit level. The opening had partly fallen shut in 1911, so that it was not possible to obtain a section of the coal, but I. C. White gives a complete section of the bed as exhibited at this mine on page 114 of Vol II of the State Survey reports.

One mile southeast of Worley this bed has been opened on the east side of the public road on Statler run on the land of Brown et al., at an elevation of 985′ A. T., aneroid where the following section was measured:

Geo. C. Wright Mine—No. 4 on Map II.

			Ft.	In.
Slate roof				
Coal upper bench	1′ 2″			
Slate, dark gray	0 5			
Coal	0′ 8″	lower bench	Washington coal	3	7
Coal, better	1 4			
	2 0			
Fire clay				4	0

Mr. Wright has this mine leased paying a royalty of $1.50 for each 100 bushels of coal mined. He sells coal on the dump at 5 cents a bushel to the farmers of the surrounding region, and reports the bottom 16 inches a very excellent smithing coal, selling it to blacksmiths for 8 cents a bushel. Separate samples were collected from the upper (Laboratory No. 614H) and lower (615H) benches, the composition and calori-

fic value of which as reported by Hite and Krak are found under **No. 4** in the table of coal analyses.

It is the Washington coal that has been mined quite extensively for local domestic fuel near the eastern border of Clay district on the Kate Core farm, 0.4 mile northwest of Core, at an elevation of 910′ A. T., aneroid, where the following section was measured at the mine entrance:

Kate Core Mine.

			Ft.	In.
Sandstone, massive, Lower Marietta			10	0
Concealed			10	0
Limestone, gray and hard	2′ 0″	Lower Washington Limestone	6	4
Shale, gray and limy	0 10			
Limestone, gray and hard	0 10			
Shale, gray and limy	2 0			
Limestone, gray and hard	0 8			
Shale, gray			2	6
Coal	0′ 5½″	Washington coal	6	4
Slate with streaks of coal	0 6			
Coal	1 0			
Shale, dark	0 3½			
Coal	1 3			
Slate, black	0 6			
Coal	2 4			
Fire clay			1	0
Concealed				

The section is very interesting in that it exhibits a fine development of the Lower Washington limestone and the relative position of the latter with respect to the Lower Marietta sandstone and the Washington coal. The latter vein is in typical development and carries almost 5 feet of coal exclusive of partings. The mine was not being operated in 1911, but it has furnished much coal for local domestic trade which sold on the dump at 4½ cents a bushel.

Passing 3.5 miles southwestward, this coal is found opened on the land of P. W. Moore, 0.2 mile southwest of Statler Run village, at an elevation of 1059′ A. T., spirit-level, where the following section was measured:

P. W. Moore Mine.

			Ft.	In.
Concealed and shale			..	..
Coal	1′ 6″	Washington coal	4	2
Shale, gray	0 8			
Coal	2 0			
Concealed				

A more complete section of the bed is exhibited at an opening on the land of Nimrod Tennant, 0.3 mile southeast of Statler Run village, where the coal crops at an elevation of 1075′ A. T., aneroid. A section here shows the following:

Nimrod Tennant Mine.

			Ft.	In.
1. Shale, dark, with limestone nodules			8	0
2. Slate, black with coal streaks	1′ 6″			
3. Coal, bony	0 10			
4. Shale, dark	0 4	Washington coal	6	10
5. Coal	1 4			
6. Shale, dark, 1″ to	0 2			
7. Coal	2 8			
8. Fire clay			1	0

That portion of the bed represented by formations Nos. 5 and 7 of the section is the best part of the vein, and is generally the only portion taken out by farmers.

Marion County.—In Marion county the thickness, character and relative position of the Washington coal in the rock column are exhibited in the sections given on preceding pages for Glover Gap, Mannington, Whetstone Run, Fairview, Dakota, Downs, Monongah N. W., Barracksville and Ices Run.

The following section was measured at the crop of this coal on a branch of Bennefield prong in the northwestern portion of Pawpaw district 0.7 mile north of Fairview:

			Ft.	In.
Concealed				
Coal, slaty	1′ 0″			
Slate, gray	0 5	Washington coal	3	11
Coal, slaty	2 6			
Fire clay shale, Washington			7	0

(Elevation of coal, 1085′ B-A. T.)

In this region, according to the Fairview section, page 129, the Washington coal comes 172 feet above the Waynesburg coal and 555 feet above the Pittsburgh bed.

Five miles southeastward D. B. Reger obtained the following section of this coal along the public road, 0.5 mile southward from Grays Flat, where it crops at an elevation of 1250′ A. T., aneroid:

			Ft.	In.
Shale and slate			3	0
Coal, slaty	1′ 4″			
Shale, gray	0 2	Washington coal	3	0
Coal, good	1 6			
Fire clay shale, Washington, greenish gray			5	0

The section is almost typical of that for the same bed in southeastern Doddridge county.

One mile southwest of Farmington, Reger collected a sample for analysis and measured the following section at the crop of the Washington coal on the head of Helens run:

			Ft.	In.
Slate, black				
Coal, slaty	2′ 0″			
Slate, black	0 2	Washington coal	3	11
Coal, good	1 9			
Fire clay				
(Elevation of coal, 1215′ B-A. T.)				

The composition and calorific value of the sample from the lower bench only as reported by Messrs. Hite and Krak, are found under **No. 5** (Laboratory No. 643H) in the table of coal analyses at the end of the chapter on Coal.

Along the southern border of Mannington district the Washington coal has been opened at an elevation of 1075′ A. T., aneroid, on the north side of Glade run, 0.4 mile northwest of Pleasantville, according to Mr. Reger who measured the following section there:

			Ft.	In.
Shale			5	0
Coal, soft, slaty	1′ 0″			
Shale, gray	0 10	Washington	4	4
Coal, hard, bony	2 6			

The coal comes 70 feet by hand-level above the top of the Daniel Mason No. 1 well (540), making the Washington-Pittsburgh coal interval 545 feet. Ten to eleven miles eastward the same interval is 552 feet, according to the accurate Monongah N. W. section, page 137.

A further discussion of the character, quality and probable available area and tonnage of the Washington coal will be given on subsequent pages in the chapter on Coal.

The Washington Fire Clay Shale.

Immediately below the Washington coal there occurs a yellowish green and impure fire clay shale that has been designated the **Washington** [30] from its association with the overlying coal. On page 163 of the Wirt-Roane-Calhoun report and 168 of the Doddridge-Harrison report of the State Survey, is given a chemical analysis of this fire clay shale as found at Spencer, Roane county.

In Monongalia and Marion counties this fire clay shale accompanies the Washington coal, and may be observed wherever the crop of the latter is exposed. It ranges in thickness from 5 to 10 feet, and is of great aid in ascertaining the horizon of the overflowing coal where the latter is often concealed by debris.

The Washington Sandstone.

The **Washington sandstone** of I. C. White[31] is quite generally present in Monongalia county. The following section measured on the east edge of the public road on Dolls run, 0.5 mile northward from Core, exhibits the relative position of this stratum to the Washington fire clay shale, Little Washington coal, and the Bristol limestone[32], and corrects some slight errors of position of the latter in former reports:

			Ft.	In.
Coal, Washington			4	0
Fire clay shale, Washington and concealed			6	0
Sandstone, massive, Washington			10	0
Shale, dark			3	0
Coal	0′ 1″	⎫		
Shale, sandy	1 0	⎪		
Coal	0 5	⎪ Little Washington coal.	5	2
Sandstone, massive	3 0	⎪		
Shale	0 6	⎪		
Coal	0 2	⎭		
Fire clay shale			7	0
Limestone, silicious, Bristol			3	0
Concealed to Dolls run level			17	0

30. Ray V. Hennen, Wirt-Roane-Calhoun Rept., p. 163-164; W. Va. Geol. Sur.; 1909.

31. Bull. 65, U. S. G. Survey, p. 38; 1891.

32. Ray V. Hennen, Doddridge-Harrison Rept., pp. 168-169; W. Va. Geol. Sur.; 1912.

No quarries were observed on this ledge in either Monongalia or Marion. The ledge does not appear to exceed 10 to 15 feet in thickness at any point.

The Little Washington Coal.

At 10 to 20 feet below the Washington coal in southwestern Pennsylvania there occurs a thin coal that has been designated the **Little Washington** from its association with the coal next above. The section above given shows that in Monongalia it belongs 19 feet below the Washington bed, between the Washington sandstone and the Bristol limestone. It appears to be quite generally present in the northeast portion of Clay district, Monongalia, and it is this bed that crops at the bend of the road, 0.5 mile northeast of Worley, at an elevation of 930′ A.T., aneroid, where it is only 10 inches thick.

One-half mile southeastward it crops at the road fork, 0.2 mile west of the mouth of Statler run, at an elevation of 945′ A.T., spirit level, and also along the road leading up the latter run, opposite the Geo. C. Wright mine (No. 4 on Map II) in the Washington coal, coming about 25 feet below the latter vein. Its section there is as follows:

		Ft.	In.
Shale			
Coal 0′ 3″			
Shale, gray 0 4	Little Washington	0	9
Coal, slaty 0 2			
Fire clay shale			

Southeastward along the hill road leading northwest from Pedlar run, 0.6 mile southwest of Core, both the Little Washington and Washington coals are exposed, where the following section was measured:

		Ft.	In.
Coal, Washington (1030′ A. T.)			
Fire clay shale, Washington		1	0
Sandstone, flaggy, with shale layers, Washington		10	0
Shale, dark, with streaks of black slate		7	4
Coal, slaty 0′ 6″			
Sandstone, shaly 5 0	Little Washington coal	5	8
Coal 0 2			

It crops at an elevation of 930′ A.T., aneroid, at the bridge over Dolls run, 0.2 mile southwest of the mouth of the latter

stream, and it is this bed that crops in the road near its fork, 0.5 mile northeastward, at an elevation of 940′ A.T., aneroid, where it is 12 inches thick. It appears to thin away southwestward in Marion county, and in the area under discussion is too thin and irregular to have any economic value.

The Bristol Limestone.

At 10 to 15 feet below the Washington coal near Bristol, Harrison county, there occurs 4 feet of hard gray limestone that has been named from that village the **Bristol**[33] **limestone**. In the Monongalia-Marion-Taylor area, the crop of this limestone was recognized at only one place. This was along the public road on Dolls run, 0.5 mile northward from Core, Clay district, Monongalia, and its thickness, character and relative position in the rock column are exhibited in the section given on a preceding page under the discussion of the Washington sandstone. On pages 134-135 of the Doddridge-Harrison report of the State Survey, the writer is evidently in error in placing the Bristol limestone above the Washington sandstone and Little Washington coal, since the section given under the discussion of the Washington sandstone shows the limestone coming below both these formations. The limestone is too thin, silicious and irregular to be considered an economic asset for Monongalia and Marion counties.

The Mannington Sandstone.

The **Mannington sandstone** of Grimsley[34] does not appear to be very well represented in Monongalia county, but in Marion it attains a fine development. Its thickness, character and relative position in the rock column in the latter area are exhibited in the sections given on preceding pages for Mannington, Rivesville, Dakota, Monongah N. W., and Barrackville. Its crop therein follows closely the same area as that outlined for the Washington coal on Map II, and in Marion it generally forms a prominent bluff around the hillsides

33. Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Survey, pp. 168-9; 1912.

34. G. P. Grimsley, Vol. IV, W. Va. Geol. Survey, p. 440; 1906.

PLATE XIII(a).—Topography of the Dunkard Series, with view of Mannington and oil wells.

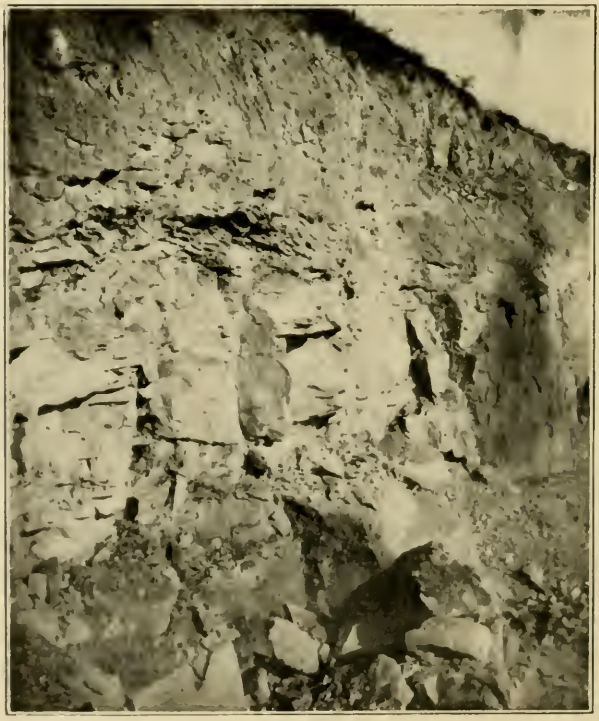

PLATE XIII(b).—The Rosetti quarry in the Mannington Sandstone at Dakota, Marion County.

wherever the latter coal crops 50 feet or more above drainage On pages 440-441 of Vol. IV of the State Survey reports, G. P. Grimsley gives a section of this stratum at its type locality at the J. D. Charlton quarry in the west edge of Mannington. Its relative position with respect to the Washington and Waynesburg "A" coals is shown in the Mannington section, page 126.

It is this stratum that has been quarried for ballast by J. P. Rosetti high up the west hillside of the Monongahela river, one mile southwest of Rivesville, as exhibited in the Dakota section, page 131. Here Mr. Reger reports it steel gray in color, weathering brown, medium grained, hard, micaceous, 23 feet thick, 60 feet below the Washington coal and 72.5 above the Waynesburg bed. No attempt has been made to quarry it for building purposes, according to Reger who reports the irregularities of the bedding and joint planes as making it unsuitable for anything but rough work.

The **Waynesburg "B" coal** of Stevenson and the **Colvin Run limestone** of White[35] were not recognized in either Marion or Monongalia.

The Waynesburg "A" Coal.

At 75 to 90 feet above the Waynesburg coal and 5 to 20 feet below the base of the Mannington sandstone there occurs a very persistent bed in Monongalia and Marion counties that has been designated the **Waynesburg "A" coal** by J. J. Stevenson[36].

In **Monongalia county** its crop is confined to a belt tending southwestward through Cass, Grant and the southeastern portion of Clay districts. In the northwest corner of Cass district this bed crops along the public road, 0.4 mile southeast of the last intersection of Dunkard creek with the W. Va.-Pa. State line, at an elevation of 945′ A.T., aneroid, where the following section was measured:

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35. I. C. White, Bull. 65, U. S. G. Survey, page 39; 1891.
36. Report K, Sec. Geol. Survey, Pa., pp. 45 and 56.

	Ft.	In.
Sandstone, flaggy and shaly, Mannington	15	0
Slate, sandy	2	0
Shale, dark	0	6
Coal, Waynesburg "A"	0	10
Limestone, gray and hard, Mt. Morris	1	0
Fire clay		

The following section was obtained at the crop of this coal in the northern edge of Grant district along the public road westward from the residence of Ray Hess, 1.7 miles southwest of Charlotte:

			Ft.	In.
Shale				
Coal, slaty	0′ 10″			
Shale, gray	0 2	Waynesburg "A" coal	1	10
Coal	0 10			
Fire clay				

Elevation of coal, 1255′ A. T., aneroid.

Here it comes about 75 feet above an opening in the Waynesburg coal.

In the southeast portion of Clay district this coal crops along the public road at an elevation of 1038′ A. T., spirit-level, 0.2 mile northwest of Center (McCurdyville), where the following section was measured:

			Ft.	In.
Sandstone, massive, Mannington			10	0
Shale, sandy			5	0
Coal	0′ 3″			
Shale	0 1	Waynesburg "A" coal	2	2
Coal	1 10			
Fire clay			5	0
Concealed			5	0
Limestone, Mt. Morris				

It is this bed that crops one-fifth mile southeast of McCurdyville along the road just north of the A. S. Kennedy No. 1 well (576), where, according to the log of the latter, it comes about 440 feet above the Pittsburgh coal.

In Marion county the thickness, character and relative position of the Waynesburg "A" coal in the rock column are exhibited in the sections given on preceding pages for Mannington, Fairview, Rivesville, Downs and Barrackville.

The following section was measured at the crop of this coal on the north bank of Buffalo creek at the western edge of Mannington:

	Ft.	In.
Sandstone, massive, Mannington	35	0
Shale, sandy	35	0
Limestone, ferriferous, shaly	0	10
Shale, dark	3	0
Coal, slaty....0′ 4″ / Coal, good....1 8 — Waynesburg "A" coal (980′ B-A. T.)	2	0
Slate, black	0	2
Fire clay shale	10	0

Three-tenths mile northeastward on the west bank of Pyles fork, in the northwest edge of Mannington, Reger collected a sample for analysis and measured the following section at the crop of the Waynesburg "A" coal:

	Ft.	In.
1. Sandstone, massive, Mannington	30	0
2. Shale, silicious, hard, brown	20	0
3. Shale, dark with ferriferous limestone nuggets	6	0
4. Coal, slaty....0′ 3″		
5. Slate, black....0 0¼		
6. Coal, good....0 11 — Waynesburg "A" coal		
7. Slate, black....0 0¼ — Elevation, 987′ L-		
8. Coal, good....0 6 — A. T.)	2	3
9. Slate, black....0 0½		
10. Coal, hard, bony.0 6		
11. Fire clay shale	10	0
12. Concealed to Pyles fork level	15	0

The composition and calorific value of the sample collected from formations Nos. 6, 7, 8 and 10 of the section as reported by Messrs. Hite and Krak are found under No. 6 (Laboratory No. 644H) in the table of coal analyses at the end of the chapter on Coal.

Mr. Reger reports an old abandoned coal opening on the Felix Cunningham farm in the southeast portion of Lincoln district, ¾ mile south of Festus, 19 feet by hand-level below the top of the Felix Cunningham No. 2269 gas well (649), that evidently correlates with the Waynesburg "A" bed, coming as it does, according to the log of the latter well, 481 feet above the Pittsburgh coal, since in this region the thickness of the Monongahela series is slightly over 400 feet as shown by diamond drill borings. Mr. Reger was unable to ascertain the thickness, but Mr. Cunningham reported the bed as carrying a parting with the best coal in the bottom bench.

Three miles northeastward and 0.2 mile northwest of the J. L. Jones Core Test No. 2 (660), this coal crops by the road-

side, at an elevation of 1220′ A. T., aneroid. Here only 12 inches of coal is visible.

Like the Jollytown coal, 300 feet higher in the measures, the Waynesburg "A" bed may sometime furnish quite a large tonnage of fairly pure coal in Monongalia and Marion counties, but it is too thin, impure, and irregular to compete with the thicker and better coals in the same region at present.

The Mount Morris Limestone.

At 2 to 5 feet below the Waynesburg "A" coal in the vicinity of Mt. Morris, Greene county, Pa., there occurs a limestone 1 to 2 feet thick, that has been so designated from this place the **Mt. Morris limestone** by I. C. White[36].

In the area under discussion this limestone was recognized at only two places, both of which were in Monongalia county. The sections given on preceding pages for the Waynesburg "A" coal at the northwest corner of Cass district and the southeast corner of Clay, report this stratum. It is too thin and irregular to have any economic value.

The Waynesburg Sandstone.

At 1 to 10 feet above the base of the Dunkard series and 15 to 20 feet below the Waynesburg "A" coal there occurs a great massive, gray and brown, sometimes pebbly sandstone, ranging in thickness from 20 to 50 feet, that was designated by the First Geological Survey of Penna. the **Waynesburg sandstone** from the town of that name in Greene county, where it attains a fine development. The thickness, character and relative position of this stratum in the rock column are exhibited in the sections given on preceding pages for Mooresville and Cassville in Monongalia county; and for Glover Gap, Mannington, Rivesville, Farmington, Downs, Worthington, Monongah N. W., Barrackville, Ices Run, and Monongah S. E. for Marion county. Its outcrop in the two counties follows practically the same areas as that outlined for the Waynesburg coal on Map II.

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36. Bull. 65, U. S. G. Survey, pages 39-40; 1891.

PLATE XIV(a).—"Watson Rock," a remnant of the Waynesburg sandstone, capping a high hill 1½ miles southeast of Monongah.

PLATE XIV(b).—Waynesburg and Gilboy Sandstones at Downs, Marion County.

No quarries were observed on this ledge in **Monongalia**, but in **Marion county** it has been quarried at several different points for bridge piers, foundations and buildings. It is this stratum that is quarried on Bennefield prong in the north edge of Fairview by John Statler, at an elevation of 1025′ A.T., aneroid. It is also this ledge that is quarried on the west side of Little Pawpaw creek, one mile south of McCurdyville, by Benjamin S. Wilson, at an elevation of 1040′ A.T., aneroid. Near Mine No. 8 of the Jamison Coal & Coke Company, ¾ mile eastward from Farmington, this sandstone crops near the shaft mouth, where it has been quarried by the company to furnish stone for the power house. The same company has quarried this stratum, according to Reger, at its No. 7 mine, ¾ mile southwestward from Barrackville. It is this sandstone that caps the summit of "Watson Knob" in a lone column, 25 feet high, ½ mile southeast of Monongah, as exhibited in the Monongah S. E. section, page 142.

In the early days of the oil and gas development within the area under discussion, it was called the "Bluff Sand" by the oil well drillers.

The Elm Grove Limestone.

The **Elm Grove limestone** of Grimsley[37] was recognized at only one point within the three counties. This was in the extreme northern edge of Pawpaw district, Marion county, on Little Pawpaw creek, near the road fork, 0.5 mile southeast of McCurdyville, where 3 feet of dark gray limestone is exposed at an elevation of 1025′ A.T., aneroid, at about 10 feet above the Waynesburg coal. A sample for analysis was collected, the composition of which is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	11.70
Ferric Iron (Fe_2O_3)	1.63
Alumina (Al_2O_3)	1.82
Calcium Carbonate ($CaCO_3$)	78.78
Magnesium Carbonate ($MgCO_3$)	1.38
Phosphoric Acid (P_2O_5)	0.50
Loss on ignition	3.70
Total	99.51

37. G. P. Grimsley, Ohio-Brooke-Hancock Rept., W. Va. Geol. Sur., p. 68; 1906.

The results reveal a limestone fairly high in silica, but adapted to agricultural purposes and road material.

The Cassville Plant Shale.

The Cassville Plant Shale is the first and lowest member of the Dunkard series, and has been so designated by Messrs. Fontaine and White[38] from the village of that name in Monongalia county, West Virginia, where it is 0 to 20 feet in thickness and full of fossil plants and insects. The reader is referred to pages 119 to 123 inclusive of Vol. II of the State Survey reports for a full description of this shale at its type locality, and the fossil flora therein.

In the area under discussion its thickness, character and position in the rock column are exhibited in the sections given on preceding pages for Cassville in Monongalia, and for Fairview, Rivesville, Downs, Worthington, Monongah N. W., and Ices Run in Marion county.

In the latter county, Mr. Reger reports fossil plants abundant at this horizon at the quarry of the Jamison Coal & Coke Company in the Waynesburg sandstone, ¾ mile southwestward from Barrackville.

AGE OF THE DUNKARD SERIES.

The lack of a Permian reptilian fauna in the Dunkard rocks has inclined geologists to place these measures in the true Carboniferous, but the fact that its formations are largely of fresh water origin would tend to show that the absence of such types should be expected. On pages 69-77 inclusive of the Ohio-Brooke-Hancock report of the State Survey, G. P. Grimsley gives an interesting account of the age of the Dunkard series as discussed by geologists in other publications along with an account of the fossil flora of the Dunkard rocks in Ohio county. From all the evidence yet collected the series evidently belongs either in the lower Permian of Europe, or in the Permo-Carboniferous.

38. Report PP, Sec. Geological Survey of Penna.

Photo by Ray Bricker.

PLATE XV.—Waynesburg Coal, Barker mine, at Georgetown, Monongalia County.

CHAPTER VI.

STRATIGRAPHY—MONONGAHELA SERIES.

The Monongahela series of the Upper Carboniferous rocks begins at base with the bottom of the Pittsburgh coal seam and extends up to the base of the Cassville Plant shale, or to the top of the Waynesburg coal. The series was so named by H. D. Rogers from the Monongahela river in the State of Pennsylvania, along which its coal beds attain a fine development. The thickness of this group of rocks in West Virgina ranges from 260 feet along the western borders of Ohio and Marshall counties, to over 435 feet in southeastern Doddridge and southwestern Harrison counties. The greater portion of the series in southwestern Pennsylvania and in the bordering counties of Brooke, Ohio, Marshall and Monongalia in West Virginia is limestone, but southwestward across the latter area, many of the limestone ledges are replaced by heavy sandstones and red beds. For a more detailed description of these beds in other portions of the State the reader is referred to pages 124-125 of Vol. II of the W. Va. Geol. Survey reports.

The following general section of the Monongahela series for West Virginia compiled by the writer from a large number of detailed sections given in other State Reports, was published on page 179 of the Doddridge-Harrison report of the State Survey. Most of the names of formations are taken from Pennsylvania places, since these rocks were first studied in that State, but later names added from West Virginia are Annabelle shale, Gilboy and Arnoldsburg sandstones, and Benwood limestone:

General Section of the Monongahela Series for West Virginia.

	Thickness. Feet.	Total. Feet.	
Coal, Waynesburg	5	5	
Shale	10	15	
Sandstone, Gilboy	35	50	
Coal, Little Waynesburg	1	51	51′
Limestone, Waynesburg	4	55	
Shale	13	68	
Sandstone, Uniontown	35	103	
Shale, brown, Annabelle, 15′ to	0	103	
Coal, Uniontown	2	105	54′
Shale	10	115	
Limestone, Uniontown	15	130	
Shale, with thin sandstones and limestones	44	174	
Sandstone, Arnoldsburg	30	204	
Coal, Lower Uniontown	1	205	100′
Shale	5	210	
Limestone, Benwood	65	275	
Sandstone, Sewickley	25	300	
Coal, Sewickley	5	305	100′
Sandstone, Lower Sewickley	25	330	
Limestone Sewickley	43	373	
Coal, Redstone	4	377	72′
Limestone, Redstone	5	382	
Sandstone Upper Pittsburgh	15	397	
Shale, limy	5	402	
Coal, Pittsburgh	8	410	33′

The Monongahela series has been elevated above drainage by the Wolf Summit, Mooresville, Indiana and Chestnut Ridge anticlines. The detailed crop of the measures is outlined on Map II. In Chapter IV several sections of the Monongahela rocks, either wholly or in part, have been given along with a table summarizing the same at the end of that chapter. The thickness is shown to vary from 350 feet in the St. Cloud section of western Monongalia to slightly over 400 feet in the Monongah region of southern Marion county. In addition to the above mentioned data, a large fund of information on the Monongahela rocks has been obtained from the logs of several diamond drill core test well borings, the most of which are located in Lincoln and Fairmont districts, Marion county. Several of these will now be given to preserve them from loss, since they give valuable data as to the thickness and character of the several coals of the series as well as the character of the material likely to be encountered in sinking shafts to the latter beds.

Morgan Fox Core Test No. 14 (621).

Located 0.5 mile north of Farmington. Authority, Consolidation Coal Company.

(Elevation, 998.50 A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	3	0	3	0	
Sandy shale	21	9	24	9	
Coal, Uniontown	0	6	25	3	25.2
Dark sandy shale	2	10	28	1	
Sandstone	6	10	34	11	
Dark slate	4	0	38	11	
Limestone, Uniontown	4	2	43	1	
Shaly fire clay	9	6	52	7	
Red shale	1	6	54	1	
Fire clay and limestone	4	0	58	1	
Blue shale	7	0	65	1	
Limestone	8	0	73	1	
Blue shale	30	0	103	1	
Bone	0	3	103	4	
Limestone	18	0	121	4	
Fire clay	8	3	125	7	
Carbon slate	1	3	130	10	
Limestone with streaks of fire clay, Benwood	41	0	171	10	
Fire clay	8	0	179	10	
Dark shale	7	8	187	6	
Sandstone	3	6	191	0	
Dark slate	7	0	198	0	
Sandstone	1	0	199	0	
Dark slate	10	2	209	2	
Coal, Sewickley (elev. at bottom. 783.25')	6	1	215	3	190'
Fire clay	2	0	217	3	
Limestone	6	0	223	3	
Gray shale	25	7	248	10	
Limestone, Sewickley	21	0	269	10	
Fire clay	3	2	273	0	
Black slate	2	0	275	0	
Shaly fire clay	9	0	284	0	
Fire clay	4	0	288	0	
Light shale	11	0	299	0	
Sandstone	2	10	301	10	
Black slate	20	0	321	10	
Sulphur coal...1' 3" / Slaty fire clay..1 0 / Coal, top.....1' 6" / Coal, middle...5 8 / Coal, bottom...1 0 — 2' 3" / 8' 2" — **Pittsburgh**	10	5	332	3	117

Elevation, bottom, 666.25' A. T.

The composition of the Sewickley coal in this boring as reported by the Company is found on a subsequent page under the discussion of this seam.

The composition of the Pittsburgh coal in the same boring is reported by the Company as follows:

	Top Coal.	Middle Coal.	Bottom Coal.	Average.
Moisture	1.29	1.25	1.34	1.27
Volatile Matter	35.77	35.43	34.88	35.42
Fixed Carbon	55.02	58.16	56.18	57.34
Ash	7.92	5.16	7.60	5.97
Totals	100.00	100.00	100.00	100.00
Sulphur	1.18	0.89	2.98	1.20
Phosphorus	0.084	0.004	0.019	0.020

The results show a very high grade low sulphur coal at this locality.

Jessie B. Martin Core Test No. 10 (623).

Located 1.5 miles southwest of Farmington, Marion County. Authority, The Consolidation Coal Co.

(Elevation, 936.10′ L.A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	13	0	13	0	
Sandstone	2	9	15	9	
Light shale	3	3	19	0	
Limestone	16	6	35	6	
Fire clay	7	9	43	3	
Coal, Lower Uniontown (elev., bottom, 891.35′ A. T.)	1	6	44	9	44.7′
Limestone	9	3	54	0	
Fire clay	3	6	57	6	
Limestone	9	6	67	0	
Green shale	3	0	70	0	
Limestone	15	8	85	8	
Shaly fire clay	13	0	98	8	
Black slate	9	0	107	8	
Sandstone	3	10	111	6	
Black slate	7	0	118	6	
Coal, Sewickley (elev., bottom, 812.60′ A. T.)	5	0	123	6	78.8
Fire clay	3	8	161	0	
Fire clay	2	10	126	4	
Limestone	4	9	131	1	
Slaty fire clay	16	0	147	1	
Sandstone	10	3	157	4	
Limestone	14	7	175	7	
Slaty fire clay	29	6	205	1	
Dark slate	15	5	220	6	
Sandstone	8	6	229	0	
Black slate	4	9	233	9	

		Thickness. Feet.		Total. Feet.		
Coal .....0′ 9″						
Slate and fire clay.1 1						
Coal 3 2						
Band 0 0½	Pittsburgh.	10	0	243	9	120.2′
Coal 0 6						
Band 0 0½						
Coal 4 5						
(Elev., bottom, 692.35′ A. T).						
Fire clay.....						

The composition of the Lower Uniontown coal as reported by the Company is found on a subsequent page under the discussion of this coal.

E. T. Wood Core Test Boring No. 3 (625).

Located 1.3 miles southeast of Downs, Marion County. Authority, Pittsburgh-Buffalo Company.

(Elevation, 973.81′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	7	0	7	0	
Sand rock.....	3	0	10	0	
Sandy shale	15	0	25	0	
Sand rock.....	13	0	38	0	
Limestone	3	0	41	0	
Sand rock.....	12	0	53	0	
Light shale.....	13	0	66	0	
Gray shale.....	8	0	74	0	
Limestone	7	0	81	0	
Gray shale.....	1	6	82	6	
Limestone, shale streaks.....	60	6	143	0	
Green shale.....	23	0	166	0	
Gray slate.....	6	6	172	6	
Black slate.....	2	0	174	6	
Coal, Sewickley.....	5	3	179	9	179.7′
Fire clay.....	2	10	182	7	
Limestone	7	0	189	7	
Gray shale, lime streak.....	14	5	204	0	
Hard sand rock.....	13	0	217	0	
Limestone	12	0	229	0	
Gray shale.....	18	0	247	0	
Black slate and fire clay.....	1	8	248	8	
Sandy shale.....	26	4	275	0	
Gray slate.....	13	1	288	1	
Coal, Pittsburgh (Bottom, 677.56′ A. T.).	8	2	296	3	116.5′

According to determination made by Reger with hand-level, the boring starts 2½ feet below the Uniontown coal, and 110 feet below the top of the Waynesburg bed—4 feet thick—giving the total thickness of the Monongahela series here as 406′ 3″.

Absalom Martin Core Test Boring (634A).

Located 1.2 miles north of Annabelle, Lincoln district, Marion County. Authority, Pittsburgh-Buffalo Company.

(Elevation, 1122.07′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Dunkard Series (29′)					
Surface	6	0	6	0	
Hard sandy shale	23	0	29	0	29′
Monongahela Series (415′)					
Gray slate (coal seams) .3′ } Waynesburg Coal .3 } coal	6	0	35	6	
Soapstone	13	6	49	0	
Light rock	31	0	80	0	
Dark gray shale	11	0	91	0	
Light rock	13	0	104	0	
Olive shale	10	0	114	0	
Limestone, Uniontown	12	0	126	0	
Dark gray shale	6	0	132	0	
Fire clay	2	0	134	0	
Gray shale	10	0	144	0	
Lime	10	0	154	0	..
Gray slate	4	0	158	0	
Gray slate	4	0	162	0	
Sandy limestone	22	0	184	0	
Limestone	11	0	195	0	
Hard shale	20	0	215	0	
Limestone	4	0	219	0	
Olive shale	2	0	221	0	
Limestone	7	0	228	0	
Dark and gray shales	3	0	231	0	
Limestone	6	0	237	0	
Hard gray shales	5	0	242	0	
Streaky limestone	38	0	280	0	
Limestone	12	0	292	0	
Light blue sandy shale	8	0	300	0	
Limestone	2	0	302	0	
Light blue shale	4	0	306	0	
Limestone	1	0	307	0	
Gray shale	6	0	313	0	
Black slate	2	0	315	0	
Coal, Sewickley	5	2	320	2	291.2′
Fire clay	2	6	322	8	
Limestone	2	8	325	4	
Shaly limestone	4	0	329	4	
Sandy shales	31	0	360	4	
Limestone	16	0	376	4	
Sand rock	3	0	379	4	
Sandy shale	7	0	386	4	
Limestone	4	0	390	4	
Sandy slate	7	0	397	4	
Gray shale	10	0	407	4	
Light shale	4	0	411	4	
Gray slate	11	0	422	4	
Dark slate	10	6	432	10	
Sandy limestone	1	2	434	0	
Coal and slate .3′ 0″ } Pittsburgh coal. Coal .7 0 } (Bottom 678.07′ A. T.)	10	0	444	0	113.8′
Fire clay					

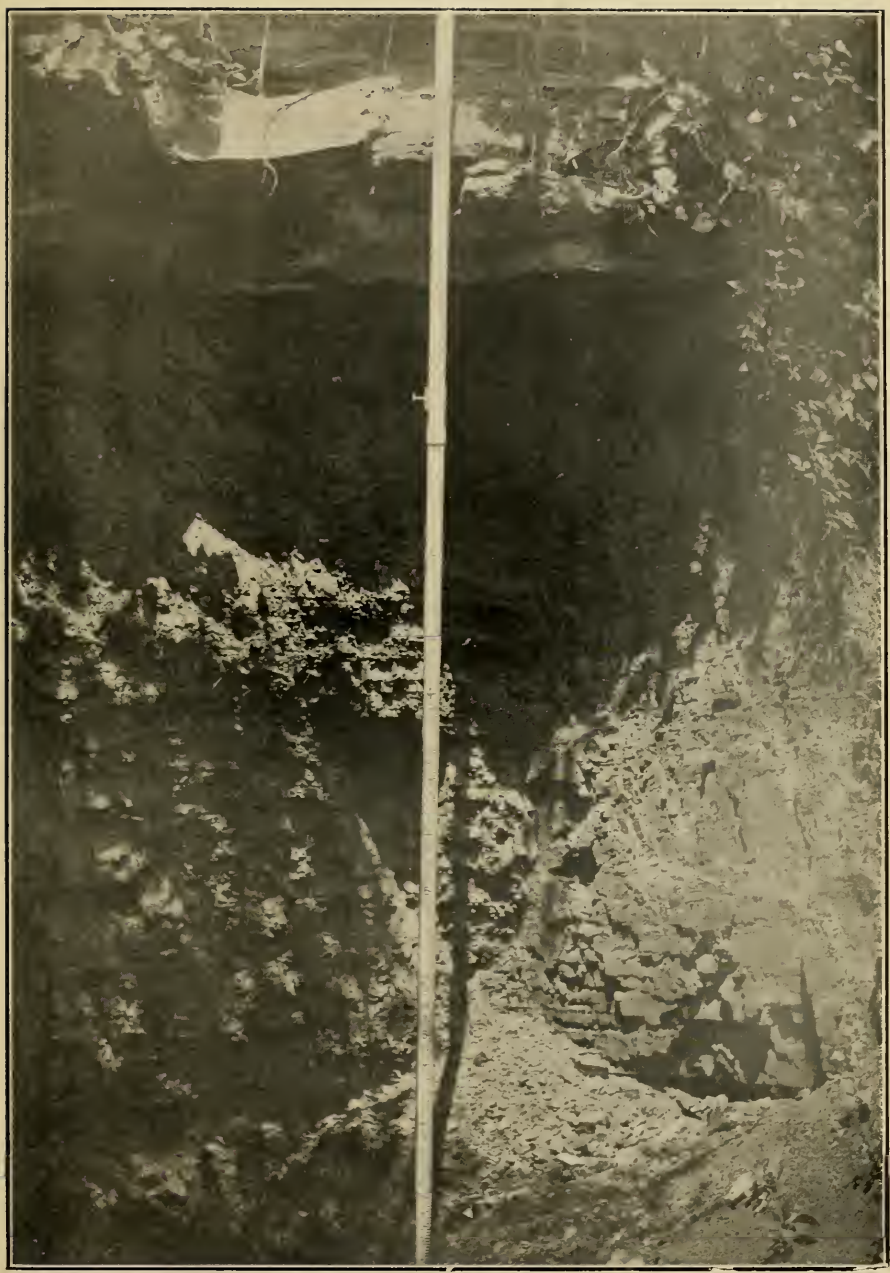

Photo by Ray Bricker.

PLATE XVI.—Sewickley Coal outcrop, Harvey Fisher farm, opposite Round Bottom, Monongalia County.

The accurate log of the **W. S. Parish No. 11 Core Test Boring,** (638), located one mile north of Festus, Lincoln district, Marion county, has been published in full on pages 678-679 of Vol. II(A) and pages 175-176 of the Wirt-Roane Calhoun report of the State Survey. This is an important record in that it gives the true position of the Lower Uniontown coal where the latter was first named.

The composition of the Sewickley coal in the latter boring, as reported by the company is given on a subsequent page under the discussion of this bed.

Olive Minnear No. 2 Core Test (639 A).

Located 0.8 miles northwest of Festus. Authority, Pittsburgh-Buffalo Company.

(Elevation, 1006.79′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	4	0	4	0	
Gray shale	10	0	14	0	
Sandy limestone	4	0	18	0	
Red shale	5	0	23	0	
Hard gray shale	18	0	41	0	
Fire clay	2	0	43	0	
Hard gray shale	7	0	50	0	
Limestone	3	6	53	6	
Fire clay	1	6	55	0	
Limestone	6	0	61	0	
Hard gray shale	4	0	65	0	
Soft gray and red shale	4	6	69	6	
Fire clay	5	6	75	0	
Limestone	5	0	80	0	
Hard gray shale	4	0	84	0	
Limestone	2	0	86	0	
Light shale	3	0	89	0	
Limestone	9	0	98	0	
Hard shale	2	0	100	0	
Limestone	3	0	103	0	
Dark shale	3	0	106	0	
Limestone	5	0	111	0	
Gray shale	1	0	112	0	
Limestone	7	0	119	0	
Gray shale	1	0	120	0	
Limestone	9	0	129	0	
Hard sandy shale	4	0	133	0	
Sand rock	1	0	134	0	
Soft gray shale	2	6	136	6	
Slate	2	0	138	6	
Coal. Sewickley	6	1	144	7	144.6′
Hard sandy shale	27	5	172	0	
Sand rock	2	0	174	0	
Hard gray shale	5	0	179	0	

	Thickness. Feet.		Total. Feet.		
Soft gray shale	9	0	188	0	
Limestone, Sewickley	12	0	200	0	
Sandy shale	19	0	219	0	
Limestone	2	0	221	0	
Gray shale	6	0	227	0	
Sandy shale	8	0	235	0	
Soft gray shale	10	6	245	6	
Sandy shale	4	9	250	3	
Dark slate	6	0	256	3	
Gray sandy shale	4	9	261	0	
Dark slate	6	10	267	10	
Coal, Pittsburgh (Bottom, 731.96' L-A. T.)	7	0	274	10	130.2'
Fire clay					

Jane Downs Core Test No. 4 (640A).

Located 0.4 mile northwest of Annabelle, Marion County. Authority, Pittsburgh-Buffalo Company.

(Elevation, 1064.11' L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	10	0	10	0	
Gray shale	5	0	15	0	
Sand rock	4	0	19	0	
Gray sandy shale	12	0	31	0	
Dark sandy shale	4	0	35	0	
Fire clay	1	6	36	6	
Dark shale	3	8	40	2	
Black slate and coal, (Uniontown)	1	0	41	2	41.2'
Sand rock	2	10	44	0	
Dark shale	10	0	54	0	
Gray shale	7	0	61	0	
Sandy shale	2	0	63	0	
Fire clay	3	0	66	0	
Sandy shales	3	0	69	0	
Sand rock and shales	14	0	83	0	
Limestone	2	0	85	0	
Gray sandy shales	5	0	90	0	
Soft sandy shales	4	0	94	0	
Gray sandy shales	19	0	113	0	
Limestone	2	0	115	0	
Gray shale	3	0	118	0	
Limestone	4	0	122	0	
Gray shale	5	0	127	0	
Limestone	7	0	134	0	
Soft gray shale	3	0	137	0	
Limestone	2	0	139	0	
Soft gray shale	2	0	141	0	
Limestone	1	0	142	0	
Fire clay	1	0	143	0	
Limestone	8	0	151	0	
Gray shale	2	0	153	0	
Limestone	3	0	156	0	
Sandy shale	2	0	158	0	
Limestone	10	0	168	0	

	Thickness. Feet.	In.	Total. Feet.	In.	
Gray shale	1	0	169	0	
Limestone	26	0	195	0	
Green shale—hard bands	10	0	205	0	
Slate and bone	1	10	206	10	
Coal, Sewickley	6	2	213	0	171.8′
Green and gray sandy shale	14	0	227	0	
Sand rock—hard bands	21	0	248	0	
Limestone	3	0	251	0	
Gray shale	4	0	255	0	
Limestone	15	0	270	0	
Gray shale—lime streaks	16	0	286	0	
Limestone	5	0	291	0	
Light shale and black slate	1	10	292	10	
Shaly limestone	17	10	310	8	
Gray, black and sandy slate	16	3	326	11	
Coal ....0′ 4″ / Top slate....1 9 / Coal ....7 10 — **Pittsburgh coal**	9	11	336	10	123.8′
Bottom of Pittsburgh coal, 727.28′ L-A. T.					

Mary Hawkins Core Test No. 13 (643).

Located 0.6 mile southeast of Sturms Mill, Marion County. Authority, Consolidation Coal Company.

(Elevation, 946.06′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface	6	6	6	6
Limestone	9	0	15	6
Sandstone	3	6	19	0
Soft shale	8	0	27	0
Slaty fire clay	10	0	37	0
Limestone	5	6	42	6
Fire clay	0	7	43	1
Coal and slate, Redstone, (Elev., bottom, 902.73′ L-A. T.)	0	3	43	4
Dark shale	2	4	45	8
Limestone	15	4	61	0
Fire clay	4	6	65	6
Coal ....0′ 6″ / Slate ....1 6 / Coal ....2 0 / Binder ....0 0½ / Coal ....0 6½ / Binder ....0 0½ / Coal ....2 3 / Binder ....0 0½ / Coal ....2 0½ — **Pittsburgh....** (Elevation, bottom, 871.60′ L-A. T.)	8	11½	74	5½
Fire clay				

Z. F. Davis Core Test No. 4 (646).

Located at junction of Martins and Helens runs. Authority, Consolidation Coal Company.

(Elevation, 964.65′ L-A. T.)		Thickness. Ft.	In.	Total. Ft.	In.	
Surface		5	10	5	10	
Limestone		7	8	13	6	
Fire clay		4	6	18	0	
Limestone		8	6	26	6	
Green shale		5	3	31	9	
Limestone		21	0	52	9	
Light shale		10	0	62	9	
Sandstone		3	7	66	4	
Black slate		2	2	68	6	
Coal 1′ 8″						
Slate 0 0½	Sewickley ...	6	0	74	6	74.5′
Coal 0 6	(Elevation,					
Slate 0 1	bottom, 890.15′					
Coal 3 5	L-A. T.)					
Bony coal 0 3½						
Fire clay		14	0	88	6	
Gray shale		16	7	105	1	
Black slate		0	2	105	3	
Fire clay		1	1	106	4	
Sandy shale		8	6	114	10	
Fire clay		4	4	119	2	
Limestone		11	6	130	8	
Green shale		14	10	145	6	
Limestone		9	0	154	6	
Fire clay		18	2	172	8	
Light shale		12	0	184	8	
Dark slate		7	5	192	1	
Sandstone		3	2	195	3	
Black slate		2	8	197	11	
Coal 0′ 5″						
Fire clay 1 0						
Black slate 0 4	Pittsburgh....	9	5	207	4	132.8′
Coal 2 5½	(Elevation,					
Bone 0 0½	bottom, 757.32′					
Coal 0 6	L-A. T.)					
Bone 0 0½						
Coal 4 7½						
Fire clay						

According to Mr. Reger, the Lower Uniontown coal—6 inches thick—crops flush with the top of the boring.

The composition of the Sewickley coal, as reported by the company, is found on a subsequent page under the discussion of this coal.

W. P. Fortney Core Test No. 3 (647).

Located on Tevebaugh creek, Marion county, 1 mile northwest of Worthington. Authority, Consolidation Coal Company.

(Elevation, 917.65' L-A. T.)		Thickness. Ft.	In.	Total. Ft.	In.	
Surface		5	0	5	0	
Limestone		25	8	30	8	
Green shale		3	0	33	8	
Light shale		10	5	44	1	
Slate		3	4	47	5	
Coal 1' 4" / Slate 1 3 / Coal 3 4	Sewickley (Elevation, bottom, 864.3' L-A. T.)	5	11	53	4	53.3'
Fire clay		8	6	61	10	
Sandy shale		3	3	65	1	
Sandstone		3	5	68	6	
Sandy shale		34	6	103	0	
Limestone		11	8	114	8	
Fire clay		5	6	120	2	
Sandstone		3	8	123	10	
Gray shale		7	7	131	5	
Limestone		4	0	135	5	
Light shale		23	2	158	7	
Gray shale		2	0	160	7	
Sandstone		3	8	164	3	
Gray shale		10	4	174	7	
Black slate		8	1	182	8	
Coal 0' 7½" / Slate 0 6 / Coal 2 7 / Bone 0 0¾ / Coal 0 6¼ / Bone 0 1 / Coal 0 2½ / Bone 0 0¼ / Coal 4 6¼	Pittsburgh (Elevation, bottom, 725.86' L-A. T.)	9	1½	191	9½	138.5'
Fire clay						

The composition of the Sewickley coal in this boring as reported by the company, is found on a subsequent page under the discussion of this coal.

Nancy Billingsley Core Test No. 5 (652).

Located on Camp run, 0.5 mile northwest of Hutchinson. Authority, Consolidation Coal Company.

(Elevation, 993.85')	Thickness. Ft.	In.	Total. Ft.	In.
Surface	12	0	12	0
Limestone	1	0	13	0
Fire clay	3	0	16	0
Limestone and shale	57	6	73	6
Fire clay	6	3	79	9

	Thickness. Feet.	In.	Total. Feet.	In.	
Coal, Sewickley, (elevation, bottom, 913.77′ L-A. T.)	0	4	80	1	80.1′
Fire clay	2	9	82	10	
Limestone	1	0	83	10	
Fire clay	9	2	93	0	
Sandy shale	10	4	103	4	
Fire clay	3	10	107	2	
Sandy shale	13	3	120	5	
Fire clay	5	3	125	8	
Limestone	11	10	137	6	
Green shale	4	0	141	6	
Sandstone	2	5	143	11	
Light shale	6	10	150	9	
Limestone	5	0	155	9	
Fire clay	2	4	158	1	
Light shale	1	7	159	8	
Limestone	6	0	165	8	
Fire clay	8	2	173	10	
Sandy shale	6	10	180	8	
Sandstone	2	0	182	8	
Slate and sandstone	13	1	195	9	
Black slate	1	5	197	2	
Coal ....1′ 2″ Slate ....0 10 Coal ....2 11 Bone ....0 0½ Coal ....0 6½ Bone ....0 2 Coal ....4 2 Fire clay	9	10	207	0	126.9′

Pittsburgh (Elevation, bottom, 786.85′ L-A. T.)

The composition of the Sewickley coal in this boring as reported by the company is found on a subsequent page under the discussion of this coal.

Wm. F. Sandy Core Test No. 12 (653).

Located on Sandys run, Marion County, 0.5 mile west of Hutchinson. Authority, Consolidation Coal Company.

(Elevation, 1100.82′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.	
Surface	20	0	20	0	
Green shale	2	5	22	5	
Limestone	12	5	34	10	
Light shale	21	2	56	0	
Limestone	12	6	68	6	
Gray shale	7	2	75	8	
Limestone	2	7	78	3	
Slaty fire clay	3	5	81	8	
Coal, Lower Uniontown	1	6	83	2	83.2′
Limestone	25	8	108	10	
Green shale	1	0	109	10	
Limestone	42	3	152	1	
Green shale and lime	2	10	154	11	

		Thickness. Feet.	In.	Total. Feet.	In.	
Coal .....0' 2"	Sewickley					
Limestone...0 7	(Elevation, bottom,	2	2	157	1	73.9'
Coal 1 5	943.74' L-A. T.)					
Limestone		1	0	158	1	
Fire clay		3	4	161	5	
Limestone		1	0	162	5	
Shaly fire clay		3	8	166	1	
Sandstone		7	7	173	8	
Sandy shale		3	7	177	3	
Fire clay		2	4	179	7	
Light shale		2	9	182	4	
Sandstone		13	4	195	8	
Dark slate		6	6	202	2	
Limestone		13	3	215	5	
Dark slate		14	0	229	5	
Limestone		3	3	232	8	
Fire clay		2	4	235	0	
Coal, Redstone		0	2	235	2	78.1'
Fire clay		31	8	266	10	
Black slate		4	11	271	9	
Coal .....0' 8"						
Slate 2 3						
Coal 2 3						
Binder ...0 1	Pittsburgh	10	6	282	3	47'
Coal 0 6	(Elevation, bottom,					
Binder ...0 0½	818.57' L-A. T.)					
Coal 0 4						
Binder ...0 0½						
Coal 4 4						
Fire clay						

Curtis Fletcher Core Test No. 9 (655).

Located on Buffalo Creek, Marion County, 1 mile east of Farmington. Authority, Consolidation Coal Company.

(Elevation, 917.63' L-A. T.)		Thickness. Ft.	In.	Total Ft.	In.	
Surface		10	5	10	5	
Limestone		21	6	31	11	
Light shale		2	5	34	4	
Limestone		8	0	42	4	
Sandstone		7	0	49	4	
Dark sandy shale		19	8	69	0	
Dark shale		5	11	74	11	
Sandstone		1	0	75	11	
Dark slate		5	8	81	7	
Coal .....1' 0"						
Slate binder.0 1						
Coal 1 5	Sewickley					
Slate binder.0 1	(Elevation, bottom,					
Coal 2 2	830.38' L-A. T.)..	5	8	87	3	87.2'
Slate binder.0 3						
Coal 0 8						
Fire clay		2	10	90	1	
Limestone		2	6	92	7	

	Thickness. Feet.	In.	Total. Feet.	In.	
Slaty fire clay	16	0	108	7	
Sandstone	13	3	121	10	
Redstone? coal and slate (Lower Sewickley)	0	2	122	0	34.8′
Dark slate	0	3	122	3	
Shaly fire clay	6	0	128	3	
Limestone, Sewickley	15	8	143	11	
Fire clay	31	0	174	11	
Sandy shale	10	2	185	1	
Black slate	13	0	198	1	
Coal ....1′ 0″					
Slate ...0 5					
Coal 2 11					
Binder ..0 0½	Pittsburgh				
Coal 0 2½	(Elevation, bottom,				
Binder ..0 0½	710.05′ L-A. T.)..	9	6	207	7	85.6′
Coal 0 4					
Binder ..0 0½					
Coal 4 6					
Fire clay					

The composition of the Sewickley coal in this boring as reported by the company is found on a subsequent page under the discussion of this coal.

The log of the **Nancy Martin Core Test Well No. 6** (659) of the Consolidation Coal Company, located on Mill Fall run, Marion county, a mile and a half north of Monongah, is published in connection with the section for Monongah, N. W., page 137. The composition of the Sewickley coal in this boring as reported by the company is found on a subsequent page under the discussion of this coal.

Morgan-Billingslee Core Test No. 8 (669).

Located on Buffalo creek, Marion County, 1.8 miles west of Barrackville. Authority, Consolidation Coal Company.

(Elevation, 914.17′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface	5	2	5	2
Limestone	53	0	58	2
Shale with lime streaks	14	6	72	8
Black shale	6	0	78	8
Sandstone	3	2	81	10
Black slate	7	8	89	6

		Thickness. Feet.	In.	Total. Feet.	In.	
Coal .....1′ 10″ Slate, binder..0 0½ Coal .....3 0½ Binder .....0 1 Coal .....0 3 Fire clay.....3 5 Coal .....0 1 Slate .....0 4 Coal 0 4	Sewickley ..	9	5	98	11	98.9
Fire clay.....		2	3	101	2	
Limestone		1	2	102	4	
Fire clay.....		7	6	109	10	
Sandstone		8	5	118	3	
Sandy shale.....		12	0	130	3	
Fire clay.....		3	4	133	7	
Limestone		1	7	135	2	
Gray shale.....		5	4	140	6	
Limestone		23	6	164	0	
Fire clay.....		4	0	168	0	
Black slate (fossil).....		5	6	173	6	
Shale mixed with lime.....		6	6	180	0	
Fire clay.....		6	5	186	5	
Slaty fire clay.....		8	0	194	5	
Dark slate.....		5	8	200	1	
Sandy shale.....		3	6	203	7	
Sandstone		3	4	206	11	
Black slate.....		11	2	218	1	
Coal .....0′ 8″ Black slate.0 10½ Coal .....2 7½ Binder .....0 0½ Coal .....0 8 Binder .....0 0¾ Coal 5 0	Pittsburgh .... (Elevation, bottom, 686.17′ L-A. T.)	9	11¼	228	0¼	129.1′
Fire clay.....						

The composition of the Sewickley coal in this boring, as reported by the company, is found on a subsequent page under the discussion of this seam.

The two following sections of the Monongahela measures were kindly furnished the Survey from the logs of two shafts by the Jamison Coal & Coke Company at its Mine No. 7 at Barrackville, Marion county. Although the shafts are only a short distance apart, yet the records show quite a variation in the formations therein:

Section of Hoisting Shaft No. 1, Mine No. 7, at Barrackville.

(Elevation of top, 966.9′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Coping	1	11	1	11
Clay	7	7	9	6

		Thickness. Feet.	In.	Total. Feet.	In.	
Shale		4	0	13	6	
Limestone, Uniontown		0	11	14	5	
Fire clay		7	8	22	1	
Sandstone		1	10	23	11	
Fire clay or gray shale (Sept. 1, 1909)		4	0	27	11	
Fire clay or gray shale		48	11	76	10	
Limestone (Oct. 1, 1909)		13	1	89	11	
Limestone		16	10	106	9	
Gray shale		3	0	109	9	
Limestone		9	0	118	9	
Gray shale		4	10	123	7	
Limestone		11	2	134	9	
Limestone		3	2	137	11	
Gray shale		11	11	149	10	
Slate		9	6	159	4	
Coal 3′ 6″ Slate 0 6 Bone coal 2 7	Sewickley	6	7	165	11	165.9′
Slate		2	0	167	11	
Fire clay		2	10	170	9	
Limestone		1	7	172	4	
Gray shale, (Nov. 1, 1909)		7	7	179	11	
Gray shale		4	3	184	2	
Sandstone		8	8	192	10	
Limestone and gray shale, mixed		14	10	207	8	
Gray shale		4	6	212	2	
Limestone		1	2	213	4	
Gray shale		3	3	216	7	
Limestone, mixed		3	10	220	5	
Slate		1	0	221	5	
Limestone		12	11	234	4	
Gray shale		2	2	236	6	
Limestone		10	6	247	0	
Shale, hard sand		12	8	259	8	
Shale, gray		4	7	264	3	
Sandstone (Dec. 1, 1909) 5′ 8″ Sandstone 10 7 Sandstone and slate, mixed 5 8 Sandstone 5 2	Upper Pittsburgh sandstone.	27	1	291	4	
Slate		1	10	293	2	
Coal. Pittsburgh (Bottom elevation, 664.6′ L-A. T.)		9	1	302	3	136.3′

Section of "B" Shaft, Plant No. 7, Barrackville.

(Elevation, 960.6′ L-A. T.)	Thickness Ft.	In.	Total. Ft.	In.
Clay	3	7	3	7
Shale	4	6	8	1
Fire clay	2	0	10	1
Limestone	1	0	11	1
Fire clay	3	0	14	1

	Thickness. Feet.	In.	Total. Feet.	In.	
Shale, sandy	3	10	17	11	
Fire clay	52	2	70	1	
Limestone	25	0	95	1	
Shale, gray	3	0	98	1	
Limestone	14	6	112	7	
Shale, gray	3	0	115	7	
Limestone	14	10	130	5	
Shale, gray	13	10	144	3	
Slate	4	5	148	8	
Coal, Sewickley	6	2	154	10	154.9′
Slate	4	6	159	4	
Shale, sandy, and fire clay	5	0	164	4	
Slate	4	11	169	3	
Shale	5	2	174	5	
Limestone	1	4	175	9	
Shale	10	0	185	9	
Sandstone	12	1	197	10	
Shale	12	6	210	4	
Slate and coal (Lower Sewickley)	1	1	211	5	56.5′
Shale	13	7	225	0	
Limestone	3	6	228	6	
Shale	1	3	229	9	
Limestone	13	1	242	10	
Shale	5	0	247	10	
Limestone	1	3	249	1	
Shale	4	5	253	6	
Slate	2	2	255	8	
Shale	12	5	268	1	
Sandstone	8	5	276	6	
Slate	5	4	281	10	
Coal .....0′ 10″ Slate .....0 7 Coal .....9 2 — **Pittsburgh** (Bottom, 668.2′ L-A. T.)	10	7	292	5	81′

The following shaft record was kindly furnished the Survey by the Four States Coal & Coke Company from its mine at Annabelle on Tevebaugh creek, Marion county:

Air Shaft Record, Annabelle Mine.

(Elevation of top. 1048′ L-A. T.) Monongahela Series (303.2)	Thickness. Ft.	In.	Total. Ft.	In.
Top soil and red clay	7	0	7	0
Sand and gravel	5	0	12	0
Fire clay, soft	6	0	18	0
Shale, gray	4	0	22	0
Fire clay, hard gray	7	0	29	0
Red shaly clay	3	0	32	0
Shale, hard gray	2	0	34	0
Fire clay soft	5	0	39	0
Fire clay, sandy	6	0	45	0
Fire clay	4	0	49	0
Slate, black and hard	2	0	51	0
Fire clay, soft	6	0	57	0

	Thickness. Feet.	In.	Total. Feet.	In.	
Fire clay with streaks of shale	3	0	60	0	
Fire clay	23	0	83	0	
Fire clay and shale	4	0	87	0	
Limestone, gray	4	0	91	0	
Fire clay and red shale	2	0	93	0	
Limestone, white	7	0	100	0	
Fire clay	7	0	107	0	
Fire clay with streaks of shale	10	0	117	0	
Fire clay	6	0	123	0	
Limestone in ledges	5	6	128	6	
Limestone, white	4	3	132	9	
Fire clay	1	0	133	9	
Slate, black	2	10	136	7	
Limestone in ledges	3	5	140	0	
Limestone, brown	6	0	146	0	
Slate, black	2	6	148	6	
Limestone, brown	9	6	158	0	
Fire clay, soft	1	0	159	0	
Slate and fire clay	4	0	163	0	
Slate, black	2	6	165	6	
Limestone, brown	7	0	172	6	
Slate, black	2	4	174	10	
Coal, Sewickley (elevation, bottom, 867' L-A. T.)	6	2	181	0	181'
Slate and fire clay	2	6	183	6	
Limestone, white	5	6	189	0	
Sandstone	1	6	190	6	
Fire clay and slate	2	6	193	0	
Soapstone and shale	2	6	195	6	
Sandstone, Lower Sewickley	20	0	215	6	
Slate, black	4	6	220	0	
Fire clay, soft	1	6	221	6	
Limestone, brown	7	6	229	0	
Limestone, white	6	0	235	0	
Sandstone, blue	13	0	248	0	
Limestone, brown	4	0	252	0	
Fire clay and slate	2	0	254	0	
Fire clay	5	0	259	0	
Fire clay, hard, and slate	10	0	269	0	
Slate, black	5	6	274	6	
Sandstone, Upper Pittsburgh	7	0	281	6	
Slate, black	10	8	292	2	
Draw slate	2	6	294	8	
Roof coal...0 9″					
Coal 1 9½					
Binder 0 1½					
Coal 1 6					
Binder 0 0¼					
Coal 0 11	Pittsburgh coal	8	6¾	303	2¾	122.2'
Binder 0 0½					
Coal 2 2¾					
Binder 0 0¼					
Coal 1 2					
Conemaugh Series (4')					
Fire clay	1	6	304	8¾	
Sandstone, blue	2	6	307	2¾	4'

A considerable area of the Monongahela series has escaped erosion in Taylor county in that portion of the Ligonier Basin southwestward from Pruntytown.

The following section was measured with hand-level by Mr. Reger from the summit of a high knob, located 1 mile southwest of Pruntytown, Taylor county:

Section One Mile Southwest of Pruntytown, Courthouse District.

	Thickness. Feet.	Total. Feet.	
Concealed from top of knob	30	30	
Limestone, good	2	32	
Concealed	30	62	
Sandstone, shaly	6	68	
Limestone, good, Benwood	5	73	
Concealed	31	104	
Limestone	2	106	
Shale, limy	11	117	
Shale, brown and sandy	17	134	
Slate, black, (Sewickley coal horizon)	0.5	134.5	134.5′
Limestone, good	2.5	137	
Shale, gray	3	140	
Sandstone	17	157	
Concealed	88	245	
Coal, Pittsburgh	7	252	117.5′

Only the basal portion of the series has escaped erosion here, as is likewise noted in the following section measured by Reger southwestward from the summit of Plummer Knob.

Plummer Knob Section, Courthouse District.

	Thickness Feet.	Total Feet.
Sandstone, buff, medium grained, hard, capping knob	20	20
Concealed	60	80
Sandstone, brown and flaggy	13	93
Limestone, Benwood	5	98
Concealed	10	108
Concealed and limy shale	45	153
Sandstone, brown and soft, Lower Sewickley	44	197
Concealed	69	266
Coal, Pittsburgh	8	274

DESCRIPTION OF THE MONONGAHELA FORMATIONS.

The Waynesburg Coal.

The **Waynesburg coal** is the topmost formation of the Monongahela series. It attains its best development of the entire Appalachian field in Monongalia and Marion counties, and is often named the "Mt. Morris coal" and "Fairview coal" by the oil and gas drillers. It is always multiple-bedded, and is frequently separated into only two benches, upper and lower, by a shale parting 1 to 36 inches thick, the whole sometimes attaining a thickness of 10 to 12 feet. Its crop is outlined in detail on Map II. Its thickness and relative position in the rock column are exhibited in the sections given in Chapter IV for Crossroads, Mooresville, Behler and Cassville in Monongalia; and for Glover Gap, Fairview, Rivesville, Dakota, Farmington, Downs, Worthington, Monongah N. W., Barrackville and Ices Run in Marion county. It is also recorded accurately in the log of the Absalom Martin Bore Hole (634A), page 220, of this chapter.

Several detailed sections of the bed, measured at crop, will now be given by magisterial districts.

Monongalia County.—An examination of Map II will show that the crop of the Waynesburg coal is confined in Monongalia to Cass, Grant and Clay districts, and that its horizon passes into the air on the steep western slope of the Indiana anticline before reaching the Monongahela river.

In **Cass district** the following section was measured at the Wade mine, located 1.2 miles southeast of Mt. Morris, Pa.:

Clark Wade Mine, Waynesburg Coal—No. 7 on Map II.

			Feet.	Inches
1.	Sandstone, massive, Waynesburg.....			
2.	Shale, Sandy. 6′ 0″	Cassville.....	6	6
3.	Shale, dark..0 6			
4.	Coal, bony...0 5			
5.	Coal 2 6			
6.	Shale, gray, 4″ to 2 6			
7.	Coal 4 7			
8.	Coal, slaty....0 4			
9.	Coal 0 6	Waynesburg coal...	10	10
10.	Slate			

(Elevation of coal, 985′ A. T., aneroid).

A sample for analysis was collected from Nos. 5 and 7 of the section, the composition and calorific value of which are given under No. 7 (Laboratory No. 618H) in the table of coal analyses. A sample was also collected from the lower bench (No. 7) alone of the above section, the composition and calorific value of which are found under No. 7 (Laboratory No. 619H) of the same table. In each case the results show the coal to have slightly less than 1 per cent of sulphur and not over 10 per cent ash, a remarkable showing for a thick coal in a region where both the Sewickley and Pittsburgh beds have attained a fine development, all belonging in the Monongahela series.

The Wade mine has a large output for a country bank, the coal being sold to the farmers of the surrounding region for domestic fuel at the rate of 3½ cents a bushel. It is highly satisfactory as a domestic fuel, giving fine results when burned in an open grate.

The following section was measured at another mine in the Waynesburg coal in Cass district, 2 miles north 15° east of Cassville:

Chas. Brand Mine, Waynesburg Coal.—No. 7(A) on Map II.

			Feet.	Inches
Sandstone, massive, Waynesburg			50	0
Shale, dark, Cassville, 0″ to			0	6
Coal	0′	4″		
Shale	0	2		
Coal	3	0		
Slate, gray	0	4		
Coal	2	10		
Coal, slaty	0	6		
Coal	1	1	8	3
Slate				

(Elevation of coal, 1130′ A. T., aneroid).

The thick middle slate of the Wade mine has here thinned to only 4 inches, and the total section of 8′ 3″ contains only 6 inches shale and slate along with 6 inches of slaty coal.

In the southwestern corner of Cass district the following section was measured at a mine in this coal, located 0.8 mile northwest of Cassville:

Leander Sutton Mine, Waynesburg Coal.

			Feet.	Inches
Shale, gray and sandy			5	0
Coal	0′	5″		
Shale, gray	0	2		
Coal	1	2		
Shale	0	1		
Coal	1	3		
Shale, gray	1	3		
Coal	0	5		
Shale, gray	0	3		
Coal	1	1		
Shale	0	1		
Coal	1	0		
Shale, gray	1	1		
Coal	1	1		
Coal, slaty	0	4		
Coal	2	2	11	10
Fire clay shale				

(Elevation of coal, 1095′ A. T., aneroid).

The section shows the seam to be split up by several layers of shale with the best coal in the lower portion of the bed.

In **Grant district,** Monongalia, the Waynesburg coal attains a fine development as shown not only by well records but from several local mines on its crop. Along the northern border of the district the following section was measured at a mine, located 1.5 miles southwest of Charlotte and 200 yards northwest of the residence of Ray Hess:

Hess Mine, Waynesburg Coal.

			Feet.	Inches
Sandstone, massive, Waynesburg, visible			20	0
Shales, dark sandy, Cassville			12	0
Coal, slaty	0′	10″		
Shale, gray	0	3		
Coal	3	2		
Shale, gray	0	10		
Coal	4	4	9	5
Slate				

(Elevation of coal, 1220′ A. T., aneroid).

Passing southwestward in Grant district, the following section was measured at a country bank in this coal, located 1.9 miles west of Laurel Point:

A. H. Fox Mine, Waynesburg Coal.

			Feet.	Inches
Sandstone, Waynesburg				
Shale, dark and sandy, Cassville			12	0
Coal	0′	8″		
Shale, black	0	2		
Coal	3	0		
Shale, gray	2″ to 1	6		
Coal	4	10	10	2
Slate				

(Elevation of coal, 1120′ A. T., aneroid).

The middle slate or gray shale appears to be quite variable in thickness at this mine, thinning from 18 inches to only 2 inches at one point in the mine.

Messrs. J. C. Heilig and R. C. Tucker of the Baltimore & Ohio R. R. engineering force, collected samples for analysis and measured the following sections at two country banks in the Waynesburg coal in Grant district, Monongalia, the results of which through the courtesy of C. McC. Lemley, Asst. Engineer of the same company, Morgantown, W. Va., were given to the Survey:

W. A. Loar Mine.

Located 2 miles southwest of Laurel Point.

			Feet.	Inches.
1. Sandstone roof				
2. Coal	3′	0 ″		
3. Shaly sandstone	1	0		
4. Coal	1	2		
5. Slate parting	0	0½		
6. Coal	0	2		
7. Clay parting	1	3		
8. Coal	0	3		
9. Clay	0	0½		
10. Bone coal	0	4		
11. Coal	0	4		
12. Slate	0	0½		
13. Coal	1	0		
14. Slaty coal	0	4		
15. Coal, appears clean	1	5	10	4½
16. Fire clay shale bottom				

(Elevation, 1160′ A. T., aneroid).

Butts, S 76° E; faces, S 14° W; sample collected from Nos. 4, 6, 8, 10, 11, 13, 14 and 15 of above section.

Barker Mine.

			Feet.	Inches.
Located at Georgetown.				
1.	Sandstone roof.....			
2.	Coal .....0′	8 ″		
3.	Slate 0	0⅛		
4.	Coal 0	4		
5.	Coal with ten slate binders about every two inches 1	10		
6.	Shale and clay partings 1	4		
7.	Coal 0	6		
8.	Clay 0	0½		
9.	Coal, 2′ 3″ to.....3	3	7	11⅝
10.	Fire clay bottom.....			

Butts, S 75° E: faces, S 15° W; fuel used for domestic purposes and firing Georgetown mill. (Elevation, 1100′ A. T., aneroid). Sample collected from Nos. 2, 4, 5, 7 and 9 of above section.

Messrs. Hite and Krak report the composition of the samples as follows:

	W. A. Loar Mine Per cent.	Barker Mine Per cent.
Moisture	1.86	1.44
Volatile Matter.....	30.00	29.13
Fixed Carbon	53.56	49.99
Ash	14.58	19.44
Totals 100.00		100.00
Sulphur	1.24	1.88
Phosphorus	0.008	0.039

The extremely high percentage of ash in the Barker analysis is probably due to the inclusion of No. 5 of the section in the sample.

Passing westward in Grant district to the waters of Indian creek, the following section was measured at a country bank 1 mile southeast of Hagans:

			Feet.	Inches.
Shale, dark, Cassville.....			6	0
Coal, slaty.....0′	1″			
Shale, dark 0	9			
Coal 1	0			
Shale, gray.....1	6			
Cannel slate 3	0			
Coal 1	5			
Coal, slaty.....0	3			
Coal 2	4		10	4
Slate				

(Elevation of coal, 1035′ A. T., aneroid).

A sample for analysis was collected and the following section measured at a country bank in this coal along the southwest edge of Grant district, Monongalia, located 1.8 miles northwest of Arnettsville:

Wm. Glasscock Mine, Waynesburg Coal—No. 8 on Map II.

		Feet.	Inches.
1.	Shale	3	0
2.	Coal 0′ 11″		
3.	Shale, gray 1 3		
4.	Coal 3 2	5	4
5.	Slate		

(Elevation of coal, 1080′ A. T., aneroid).

The composition and calorific value of the sample from No. 4 only of section as reported by Messrs. Hite and Krak, are given under No. 8 (Laboratory No. 620H) in the table of coal analyses. The results show the bed to be unusually high in sulphur and ash. The mine was just being opened when the sample was taken. An old mine in the same seam nearby has furnished domestic fuel for the farmers of the surrounding region for the last 40 to 50 years.

In **Clay district**, Monongalia, the Waynesburg coal barely gets above drainage in the extreme southeastern corner. Here the following section was measured at a country bank, 1 mile southwest of Hagans:

Jacob R. Tennant Mine, Waynesburg Coal.

	Feet.	Inches.
Shale, dark	1	0
Coal 0′ 5″		
Shale, gray 1 3		
Coal 4 0		
Slate, gray and hard 0 5		
Coal 1 6	7	7

(Elevation of coal, 1040′ A. T., aneroid).

Marion County.—Map II shows the crop of the Waynesburg coal in Pawpaw, Lincoln and Fairmont districts, the southeast corner of Mannington district, and the northwestern corner of Grant. It attains about the same development in Marion as in Monongalia.

In Pawpaw district this coal has been opened by farmers at a number of places along its crop for local domestic fuel. A sample for analysis was collected and the following section measured at one of these mines in the north edge of Fairview:

John Statler Mine, Waynesburg Coal—No. 9 on Map II.

		Feet.	Inches.
1.	Sandstone, massive, Waynesburg.....	50	0
2.	Slate, black, Cassville.....	0	6
3.	Coal .....0′ 4 ″		
4.	Shale 0 0½		
5.	Coal 1 1		
6.	Shale, gray.....1 2		
7.	Coal 3 2	5	9½
8.	Slate		

(Elevation of coal, 1020′ A. T., aneroid).

The composition and calorific value of the sample from Nos. 5 and 7 only of the section, as reported by Messrs. Hite and Krak, are given under No. 9 (Laboratory No. 613H) in the table of coal analyses.

One-half mile southward at the southeast edge of Fairview a sample for analysis was collected and the following section measured by Mr. Reger at a mine in the Waynesburg coal:

C. J. Martin Mine, Waynesburg Coal—No. 10 on Map II.

		Feet.	Inches.
1.	Shale, gray.....		
2.	Slate, black.....	0	6
3.	Coal, slaty.....1′ 1″		
4.	Shale, gray 0 6		
5.	Coal, hard.....2 8	4	3

(Elevation of coal, 1040′ A. T., aneroid).

The composition and calorific value of the sample from the bottom bench only—No. 5 of section—as reported by Messrs. Hite and Krak, are given under No. 10 (Laboratory No. 647H) in the table of coal analyses.

Passing eastward to the waters of Little Pawpaw creek, this coal is opened at several country banks. The following section was measured at a mine, 1 mile south of McCurdyville:

Brown Tennant Mine, Waynesburg Coal.

		Feet.	Inches.
Concealed			
Shale, dark, Cassvile		10	0
Coal	0′ 9″		
Shale, gray	1 2		
Coal	4 3	6	2
Fire clay shale			

Here the upper bench has almost thinned away, while the lower one has its normal thickness of the Monongalia region to the northeast.

Passing about 3 miles southeastward in Pawpaw district we find the following section exposed at a country bank, 1 mile southwest of Arnettsville:

Alfred Valentine Mine, Waynesburg Coal.

		Feet.	Inches.
Shale			
Coal	1′ 0″		
Shale, gray	1 3		
Coal	4 4	6	7
Fire clay shale			

(Elevation of coal, 1130′ A. T., aneroid).

Through the courtesy of C. McC. Lemley, Assistant Engineer, Baltimore & Ohio Railroad Co., the Survey obtained an anlysis of a sample of this coal from an opening on the same farm, 100 yards northward from the last mentioned mine. The sample was collected by Messrs. Heilig and Tucker, and the results, as determined by J. B. Krak of the Survey staff, are as follows:

	Per cent.
Moisture	1.23
Volatile Matter	29.32
Fixed Carbon	46.62
Ash	22.83
Total	100.00
Sulphur	2.93
Phosphorus	0.008

Messrs. Heilig and Tucker report only 2′ 7½″ of the lower bench from which the sample was taken, with ¼″ sulphur band 8″ above the bottom, the band being excluded from the sample. The faulty nature of this opening as compared to that measured by the writer above, 100 yards southward, probably accounts for the high percentage of ash.

In the extreme southern point of Pawpaw district, this coal is opened on the river hill, 1 mile southwest of Rivesville. Here Reger collected a sample for analysis and measured the following section:

Monongahela Valley Traction Co Mine, Waynesburg Coal. No. 11 on Map II.

	Feet.	Inches.
1. Coal	0	8
2. Shale, gray	1	3
3. Coal, good	0	9
4. Coal, bony	0	8
5. Coal, good	2	1
Total	5	5

(Elevation of coal, 1038′ A. T., spirit leved).

The composition and calorific value of the samples from No. 1, 3 and 5 only of section, as reported by Messrs. Hite and Krak, are given under No. 11 (Laboratory No. 649H) in the table of coal analyses. The results shows the coal fairly high in sulphur, but containing slightly less than 11 per cent of ash.

In **Lincoln district**, Marion, the Waynesburg coal attains good development and has been mined at many places to furnish local domestic fuel. Along the northeastern border of the district, Reger measured the following section at an opening, 1 mile north of Upton:

	Feet.	Inches.
Sandstone, massive, Waynesburg	50	0
Shale, gray 0′ 6″		
Slate, black 0 6 } Cassville	1	0
Coal, soft 1′ 10″		
Slate, gray 1 6 } Waynesburg	6	4
Coal, hard 3 0		

(Elevation of coal, 1140′ A. T., aneroid).

Five to six miles southwestward in Lincoln district, Reger measured the following section at the crop of the Waynesburg seam in the public road on Mod run, one-fourth mile northeast of Downs:

		Feet.	Inches.
Sandstone, massive, Waynesburg		30	0
Shale, gray, Cassville		4	0
Coal	1′ 0″		
Slate	0 6		
Coal	0 6	Waynesburg coal 6	4
Shale, gray	2 0		
Coal	2 4		
Shale, gray and concealed		10	0
Sandstone in run, visible, Gilboy		15	0

(Elevation of coal, 1035 A. T., aneroid).

Although the total thickness of the bed is the same in the last two sections, yet the latter carries one foot less coal.

Slightly over a mile southeast of Downs, Reger measured the following section in the Waynesburg bed at a mine near the H. L. Sturm No. 1 gas well (626):

		Feet.	Inches.
Sandstone, massive, brown and pebbly Waynesburg			
Slate, black			
Coal	0′ 2″		
Slate, black	0 1		
Coal	0 8		
Shale, gray	0 2	Waynesburg coal . 3	6
Coal	0 9		
Shale, gray	0 8		
Coal	1 0		

(Elevation of coal, 1080′ A. T., spirit level).

Here, according to the log of the Sturm well (626), the base of the coal comes 400 feet above the top of the Pittsburgh seam, and—as Mr. Reger determined by hand-level—103 feet above the Uniontown coal.

Two miles northeastward, the Waynesburg coal crops on Laurel run, and there Reger measured the following section of the bed:

C. J. Lough Mine, Waynesburg Coal.

	Feet.	Inches.
Sandstone, massive, Waynesburg	50	0
Shale, gray	1	0
Slate, hard and black	0	9
Shale, gray	0	2

Coal	0′ 3″			
Shale, gray	0 1			
Coal, good	1 1			
Shale, gray	0 6			
Coal, bony	0 7			
Coal, good (not visible, supplied by Mr. Lough	2 0		4	6

(Elevation of coal, 1080′ A. T., aneroid).

Before the opening of the Pittsburgh bed at Farmington, this coal was mined quite extensively to furnish domestic fuel for the surrounding neighborhood.

Pasing eastward to Davy run in the eastern edge of Lincoln district this coal is found cropping a short distance above drainage, 1.4 miles northward from Katy, where Reger measured the following section:

			Feet.	Inches.
Sandstone, massive, Waynesburg				
Shale, gray, Cassville			4	0
Coal, slaty	2′ 0″	Waynesburg coal	7	0
Shale, gray	1 2			
Coal, hard, block	1 3			
Slate, black	0 1			
Coal, good	2 6			

Southwestward from the main line of the B. & O. R. R. in Lincoln district the Waynesburg coal has been mined quite extensively for local domestic fuel by farmers. The following section was measured at an opening on Little Mill Fall run, 2 miles northwest of Monongah, near the J. L. Jones core test well (660), the record of which is published on pp. 676-677 of Vol. II(A) of the State Survey reports:

J. L. Jones Mine, Waynesburg Coal.

		Feet.	Inches.
Sandstone, Waynesburg		50	0
Coal	0′ 10″		
Shale, gray	0 2		
Coal	1 0		
Shale, gray	1 3		
Coal, bony	0 3		
Coal	1 3		
Coal, bony	0 2		
Coal	1 11	6	10

Fire clay shale.

(Elevation of coal, 1155′ A. T., aneroid).

The coal is 5 inches thicker than recorded in the log of the boring (660) referred to above. The middle slate of the Mt. Morris region is present in typical development.

Two miles southwestward in Lincoln district a sample for analysis was collected and the following section measured by Reger at a farmer's opening:

W. I. Nutter Mine, Waynesburg Coal.—No. 12 on Map II.

		Feet.	Inches.
1.	Sandstone, massive, Waynesburg	40	0
2.	Shale, gray, Cassville	2	0
3.	Slate, black	0	6
4.	Coal 0′ 8″		
5.	Shale, gray 0 2		
6.	Slate, black and soft 0 6		
7.	Coal, soft 1 1		
8.	Shale, gray 1 4		
9.	Coal, hard 2 8	6	5
10.	Fire clay shale		

(Elevation of coal, 1200′ A. T., aneroid).

The composition and calorific value of the sample from Nos. 7 and 9 only of the section as reported by Messrs. Hite and Krak, are found under No. 12 (Laboratory No. 642H) in the table of coal analyses. The sulphur content is quite high, but the ash is about what should be expected.

The Waynesburg coal appears to thin down rapidly southwestward in Lincoln district as the Harrison county line is approached, as revealed by the following section measured by Reger at a mine on Camp run, 1 mile northwest of Hutchinson, just east of the point where the public road crosses the latter stream:

		Feet.	Inches.
Sandstone, massive, brown, Waynesburg		55	0
Slate		0	3
Coal 0′ 8″			
Shale, gray 1 4	Waynesburg coal	3	3
Coal 1 0			
Shale, gray, ferriferous		5	0
Sandstone, Gilboy		10	0

(Elevation of coal, 1150′ A. T., aneroid).

Here, as southwestward in Harrison county, it is too thin to be considered of any commercial value. Two and a half

miles northward in the same district it again resumes its normal thickness on a branch of Helens run, near the Clement Davis No. 1 well (644), where Reger measured the following section at an exposure in the run:

			Feet.	Inches.
Sandstone, massive, Waynesburg			30	0
Shales, dark fossil plants	0′ 4″	Cassville	1	0
Shale, gray and hard	0 8			
Coal, slaty	0′ 4″			
Slate, gray	0 1			
Coal, good	1 1			
Shale, gray	2 6			
Coal, slaty	0 4			
Slate, black	0 1			
Coal, good	0 7			
Shale, gray	1 2			
Coal, hard, slaty at top	3 0		9	2
Concealed			3	0
Sandstone, massive, Gilboy			35	0

(Elevation of coal, 1090′ A. T., aneroid).

Here the bed contains 3′ 10″ of slate and shale.

Passing six miles southwestward to Big run, the following section was obtained by Reger at an exposure along the road, one-fourth mile southwest of the R. J. Martin No. 1 gas well (545):

			Feet.	Inches.
Shale, gray			5	0
Coal	0′ 8″			
Shale, gray	1 6	Waynesburg coal	4	8
Coal, good	2 6			
Concealed			5	0

In **Mannington district,** Marion, the Waynesburg coal rises above drainage in the extreme southeast corner. Mr. Reger obtained the following section of the coal 0.9 mile eastward from Pleasantville:

	Feet.	Inches.
Sandstone, massive, Waynesburg		
Slate, black	0	3
Shale, gray	1	0
Coal, Waynesburg	2	6
Shale, gray	5	0
Sandstone, massive, Gilboy	10	0

(Elevation of coal, 1095′ A. T., aneroid).

In **Fairmont district,** the Waynesburg coal crops high in the hills over a large portion of its area, attaining a fair development. The following section was measured by Reger in the northern point of the district on the head of Finch run, near the Eli M. Rex No. 1 well (664):

		Feet.	Inches.
Shale, gray		1	0
Coal ..... 0′ 11″			
Shale, gray 1 3			
Coal, good..... 1 5	Waynesburg coal...	4	11
Slate, black..... 0 4			
Coal, good..... 1 0			
Concealed by water.....			

(Elevation of coal, 1103′ A. T., aneroid).

Slightly over two miles southeastward this coal has been opened on the east side of Finch run, ¾ mile due north of Barrackville, where the following section was measured by Reger:

		Feet.	Inches.
Shale, gray, Cassville.....		3	0
Coal ..... 0′ 5″			
Shale, gray..... 1 2			
Coal 0 10	Waynesburg coal...	5	2
Slate, black..... 0 1			
Coal 2 8			
Shale, gray.....			

(Elevation of coal, 1055′ A. T., aneroid).

In the central portion of Fairmont district a detailed section of the Waynesburg coal near the head of Little Coal run is given in the general Ices Run-Fairmont section, page 140.

Grant district, Marion county lies in the angle between the West Fork and Tygart Valley rivers. A glance at Map II will show that only a few small patches along the western border of the district remain uneroded. No openings on its crop were observed in this area, so that it was not possible to determine the thickness. The Monongah S. E. general section, page 142, exhibits only a streak of black slate at this horizon, but the coal itself may belong in the concealed interval immediately under this black slate.

Taylor County.—The Waynesburg coal has been entirely eroded in Taylor county except a few small patches in the southern portion of Flemington district. These occur in the

deep Ligonier structural basin, south and southwest of Flemington as shown on Map II, near the summits of high hills. The coal is apparently too thin in this region to have any commercial value, although no measurements were obtained of its exact thickness and bedding, due to lack of openings.

The Gilboy Sandstone.

At 5 to 10 feet below the Waynesburg coal there frequently occurs a very hard, fine grained, grayish white rock, 25 to 35 feet thick, that has been termed the **Gilboy sandstone** by I. C. White[1] from a railroad cut of that name just east of Mannington, Marion county.

Its crop follows closely that outlined for the Waynesburg coal on Map II. Its thickness and relative position in the rock column are exhibited in the sections for Mannington, Fairview, Farmington, Rivesville, Downs, Monongah N. W., and Barrackville.

Only one quarry was noted on this ledge. According to Reger, the Jamison Coal & Coke Co. has quarried this stratum along with the Waynesburg above for masonry work in its plant at Mine No. 8, at Underwood. Here the ledge is reported very broken in appearance, with numerous bedding and joint planes, some of the layers being very much cross-bedded and separated by layers of shale.

The Little Waynesburg Coal.

The **Little Waynesburg coal** of J. J. Stevenson, belonging 25 to 40 feet below the Waynesburg coal, was noted at only one point in the three counties; viz., along the Woods run hill road, 0.6 mile southwest of Stafford, Marion county, where Reger obtained the following section:

	Feet.	Inches.
Coal, Waynesburg	4	7
Concealed	20	0
Sandstone, massive, gray, micaceous, medium grained, Gilboy	25	0
Concealed	9	0
Coal, slaty, Little Waynesburg (980′ B-A. T.)	1	0
Limestone, hard, Waynesburg	10	0

1. Vol II, W. Va. Geol. Survey, p. 150; 1903.

The coal is too thin to have any economic importance in the area under discussion.

The Waynesburg Limestone.

The **Waynesburg limestone** of Stevenson and White was observed at only two localities; viz., that given for Little Waynesburg coal, where the section above shows it 10 feet thick, coming immediately under the latter coal; again on Plum run, Marion county, 1 mile northeast of Downs where a sample for analysis was collected and the following section measured by Reger at its crop on the land of Eliza Huff:

		Feet.
1.	Coal, Waynesburg	5
2.	Shale and concealed	5
3.	Sandstone, Gilboy	22
4.	Coal, Little Waynesburg (3″)	0.25
5.	Limestone, hard, Waynesburg	2

The composition of the sample as reported by Messrs. Hite and Krak under Laboratory No. 644H(a) is as follows:

	Per cent.
Silica ($Si O_2$)	12.43
Ferric Iron (Fe_2O_3)	2.42
Alumina (Al_2O_3)	1.79
Calcium Carbonate ($Ca CO_3$)	77.62
Magnesium Carbonate ($Mg CO_3$)	3.22
Phosphoric Acid ($P_2 O_5$)	0.30
Loss on ignition	2.12
Total	99.90

The results show it adapted to the manufacture of agricultural lime and road material:

It is evidently lenticular in its nature, since it is entirely absent in many places where its horizon is exposed in Monongalia and Marion counties.

The Uniontown Sandstone.

The **Uniontown sandstone** of I. C. White[3] does not attain the developemnt in the Monongalia-Marion-Taylor area that

3. Bulletin 65, U. S. G. Survey, p. 58; 1891.

it does southwestward in the State, as it has a tendency to break up into shales and sandy beds. The general sections for Dakota, Farmington, Barrackville, Ices Run-Fairmont, and Monongah S. E. exhibit its thickness and relative position in the rock column.

Only one quarry was observed on the ledge in the three counties. This was on Pawpaw creek, opposite the mouth of Toothman run, one mile northwest of Grays Flat. Here it had been quarried for ballast by the Fairmont & Clarksburg Traction Co. for the electric railroad running from Fairmont to Fairview. At this point it is 20 feet thick and comes immediately above 7 feet of hard, gray limestone, at an elevation of 995′ A.T. by aneroid.

The Annabelle Shale.

On Tevebaugh creek at Annabelle, Marion county, the Uniontown sandstone has been largely replaced by a greenish gray and brown shale, according to Reger, where it has been utilized quite successfully by the United States Sewer Pipe Company to manufacture brick for the plant and houses of the Four States Coal & Coke Co. at this place. A more detailed discussion of the clay pit and an anlysis of the shale will be given in a subsequent chapter under Clays. Its thickness and relative position in the rock column are noted in the general sections for Farmington and Barrackville. It appears to be confined largely to the southern portions of Lincoln and Fairmont districts, Marion county. It has been termed the **Annabelle shale** by Reger in gathering his notes in the field.

The Uniontown Coal.

The **Uniontown coal** of Rogers comes 90 to 110 feet below the Waynesburg coal and about 300 feet above the Pittsburgh bed. Its thickness and relative position in the rock column are exhibited in the general sections for Worthington, Monongah N. W., Barrackville and Ices Run-Fairmont, and in the records of the two following diamond drill borings:

Morgan-Fox No. 14 (621), located 0.5 mile north of Farmington.

Jane Downs No. 4 (640A), located 1.8 miles northwest of Festus.

The following section was measured at its crop on Pawpaw creek, 0.8 mile northwest of Grays Flat:

			Feet.	Inches.
Shale, gray			0	2
Coal, slaty	0′ 4½″			
Shale, gray	0 2½	Uniontown	1	4
Coal	0 9			
Shale, gray			3	0

(Elevation of coal, 1000′ A. T., aneroid).

The section shows the coal double-bedded, a feature that almost invariably accompanies this seam.

Mr. Reger reports it only 6 inches thick at Farmington, at an elevation of 955′ A.T., aneroid; and 12 inches thick, 0.3 mile northeast of Bingamon, at an elevation of 1080′ A.T., aneroid.

Sufficient data have been obtained to show that this coal is too thin, impure, and irregular in the three counties to be classed as a minable coal.

The Uniontown Limestone.

The Great Limestone of the First Geological Survey of Pennsylvania was divided by J. J. Stevenson: the **Upper,** 6 to 18 feet thick, coming immediately below the Uniontown coal, was termed the **Uniontown limestone** from its relation to the coal bed. Its thickness, character and relative position in the rock column are exhibited in the general sections for Rivesville, Dakota, Farmington, Worthington and Barrackville. Its outcrop is 100 to 120 feet in elevation below that outlined for the Waynesburg coal on Map II, wherever the latter gets more than that distance above drainage. It is usually buffish gray in color, slightly magnesian and 3 to 10 feet in thickness. It appears to attain a better development in Marion than in either of the other two counties. On Pawpaw creek its crop is well exposed opposite the mouth of Toothman run, 1 mile northwest of Grays Flat, at an elevation

of 990′ A.T., aneroid. Here it is gray, hard and 7 feet thick, coming immediately at the base of the Uniontown sandstone, the latter being quarried for ballast. The sandstone has cut away the Uniontown coal entirely.

Mr. Reger collected a sample of this limestone for analysis and measured the following section at its crop on the south bank of Buffalo creek at Farmington (Underwood Sta.):

	Feet.	Inches.
Shale, brown, Annabelle	15	0
Slate, black coaly, Uniontown, 0 to	0	6
Limestone, hard, Uniontown (950′ B-A. T.)	3	0
Shale, limy, greenish at base	15	0

The composition of the sample is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	31.63
Ferric Iron (Fe_2O_3)	2.95
Alumina (Al_2O_3)	8.14
Calcium Carbonate ($Ca CO_3$)	49.00
Magnesium Carbonate ($Mg CO_3$)	2.43
Phosphoric Acid (P_2O_5)	1.02
Loss on ignition	4.73
Total	99.90

The results show it too high in silica to have much value except for road material.

The Arnoldsburg Sandstone.

The **Arnoldsburg sandstone** of the writer[4] comes 40 to 50 feet below the Uniontown sandstone at the type locality of the former. Its thickness and relative position in the rock column are exhibited in the general sections for Downs and Tyrconnell. This stratum ranges from 15 to 30 feet thick, and it is very close-grained in texture with a greenish to bluish gray color on fresh fractures, but on old exposures changes to a brownish gray color. It is this ledge and not the Sewickley that is quarried and mined in the north edge of

4. Ray V. Hennen, Wirt-Roane-Calhoun, Rept., W. Va. G. Survey, pp. 202-204; 1911.

Fairmont by Mr. J. Fay Watson, an account of which is given by G. P. Grimsley on pages 459-460 of Vol. IV of the State Survey reports. Here it comes about 200 feet above the Pittsburgh coal and 115 feet above the Sewickley coal. It frequently forms steep bluffs around the hillsides about 175 feet below the crop of the Waynesburg coal.

The Lower Uniontown Coal.

In northern Harrison and southern Marion counties there occurs a thin coal, 10 to 18 inches thick, about midway between the Uniontown and Sewickley coals that is known as the Lower Uniontown bed. Its thickness and relative position in the rock column are exhibited in the general sections for Randall and Worthington and in the logs of the two following diamond drill borings, published on preceding pages of this report:

Jessie B. Martin No. 10 (623), located 1.5 miles S W of Farmington.

Wm. Sandy No. 12 (653), located 0.5 mile west of Hutchinson.

Through the courtesy of Frank Haas of the Consolidation Coal Co., the Survey obtained the following analysis of this coal as tested in the laboratories of the company from the core taken out of the Martin boring (623), see page 218:

	Per cent.
Moisture	1.54
Volatile Matter	38.54
Fixed Carbon	51.16
Ash	8.76
Total	100.00
Sulphur	3.56

On Tevebaugh creek, 1.2 miles northwest of Worthington, Reger collected a sample of this coal for analysis and measured the following section at a fresh exposure in a railroad cut, marked No. 13 on Map II:

	Feet.	Inches.
Sandstone, massive, Arnoldsburg	20	0
Shale	4	0
Coal, good Lower Uniontown	2	4
Shale, brown	0	4
Limestone, gray, very hard	1	0
Limestone, shaly	3	0
Limestone, hard	4	0

The composition and calorific value of the sample, as reported by Messrs. Hite and Krak, are given under No. 13 (Laboratory No. 611H) in the table of coal analyses.

The coal is too thin and irregular to be reckoned as a valuable economic asset, since the logs of several of the diamond drill borings in the region where it attains its best development reveal its entire absence.

The Fulton Green Shale.

The **Fulton Green** shale of Grimsley[5] comes 80 to 90 feet above the Sewickley coal and directly over the Benwood limestone. It is a bright green, finely laminated shale on fresh exposure, weathering to a bluish green. The following section was measured by Mr. Reger at its crop near the B. & O. R. R. Station at Barrackville, Marion county:

		Feet.	Inches.
Sandstone, massive..4'			
Shale 5	Arnoldsburg	15	0
Sandstone, massive..6			
Shale		3	0
Limestone, shaly		10	0
Shale, green, Fulton		7	0
Limestone, Benwood, to railroad grade		7	0

(Elevation of shale, 913' A. T., spirit level).

The formation is of scientific interest on account of its wide distribution, being found at the same horizon in Harrison and also in Barbour county, near Century.

The Benwood Limestone.

The **Benwood limestone,** a name applied to the lower division of the Great Limestone of Rogers by I. C. White

5. G. P. Grimsley, Ohio-Brooke-Hancock Rept., W. Va. G. Survey, p. 92; 1906.

from the town of Benwood, Marshall county, where it crops in prominent cliffs, attains a fair development in this area. Its thickness and relative position in the rock column therein are exhibited in the general sections for Dakota, Farmington, Downs, Worthington, Monongah N W, Ices Run-Fairmont, Monongah S E, Tyrconnell and Pruntytown. It crops 100 to 125 feet in elevation above the Pittsburgh coal, and is of brackish or fresh-water origin.

In **Monongalia county** this formation crops on the waters of Robinson, Scott and Dents runs and other west side tributaries of the Monongahela river. The following analysis of a sample from this limestone on Scott run, Cass district, was published on page 94 of the Ohio-Brooke-Hancock Report of the State Gelogical Survey:

	Per cent.
Lime carbonate	86.70
Magnesium carbonate	5.32
Silica	5.96
Alumina	1.06
Iron oxide	1.27
Titanium	0.07

In **Marion county** this limestone crops along the Monongahela, West Fork and Tygart Valley rivers, and a short distance back up the tributaries of the latter streams within the boundaries of the Monongahela series as outlined on Map II.

Mr. Reger collected a sample for analysis and measured the following section at an exposure in a Baltimore & Ohio Railroad cut, one-eighth mile south of Montana Mines:

		Feet.	
1.	Limestone, hard	4	
2.	Limy, shale	15	
3.	Limestone, hard	8	
4.	Limestone, shaly	9	
5.	Limestone, hard	4	
6.	Shale, limy	3	43′
7.	Coal, Sewickley		

The composition of the sample from Nos. 1, 3 and 5 only of section is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	18.79
Ferric Iron (Fe_2O_3) / Alumina (Al_2O_3)	5.79
Calcium Carbonate ($CaCO_3$)	26.56
Magnesium Carbonate ($MgCO_3$)	37.51
Phosphoric Acid (P_2O_5)	0.22
Loss on ignition and undetermined	11.13
Total	100.00

The high percentage of magnesium carbonate classes this limestone as dolomitic and adapted to the manufacture of natural cement. It should also furnish an abundance of road metal.

It is this limestone, according to Reger, that has been quarried for road metal along the river hill east of Fairmont where the following section was measured:

		Feet.	Inches.
Shale, green, Fulton		5	0
Limestone, massive, hard 10'			
Shale, limy 20	Benwood		
Limestone, shaly 35	Limestone	72	0
Shale, yellow and limy 7			
Coal, Sewickley (935' B-A. T.)		3	4

In Taylor it does not attain the development that it does in the other two counties. However, it adds greatly to the fertility of the soil southwestward from Pruntytown to the Taylor-Harrison line.

Mr. Reger collected a sample for analysis and measured the following section at an exposure of this limestone 1¼ miles southwest of Pruntytown:

		Feet.	Inches.
1.	Sandstone, shaly	6	0
2.	**Limestone, good, Benwood**	5	0
3.	Concealed	31	0
4.	Limestone	2	0
5.	Interval	139	0
6.	Coal, Pittsburgh	7	0

(Elevation of Benwood Limestone, 1462' A. T., spirit level).

The composition of the sample from No. 2 only of section, is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	8.70
Ferric Iron (Fe_2O_3)	1.61
Alumina (Al_2O_3)	0.84
Calcium Carbonate ($Ca CO_3$)	84.16
Magnesium Carbonate ($Mg CO_3$)	2.23
Phosphoric Acid (P_2O_5)	0.65
Loss on ignition	1.79
Total	99.98

The results show it to be adapted both to the manufacture of agricultural lime and road material.

The Upper Sewickley Sandstone.

A massive, arenaceous stratum, 40 to 60 feet thick, crops directly over the Sewickley coal along the Monongahela river in Monongalia and Marion counties, and this has been designated the **Sewickley sandstone** by I. C. White[6]. Its thickness and relative position in the measures are exhibited in the general sections for Mooresville, Behler and Randall in Monongalia; and for Fairview, Farmington, Downs and Monongah N W in Marion. It was not noted in any of the sections of the Monongahela series in Taylor. This sandstone is especially prominent opposite Beechwood, in Monongalia, where it crops in a great cliff 60 feet high. No quarries were observed on this ledge.

The Sewickley Coal.

The **Sewickley coal,** so named by the First Geological Survey of Pennsylvania, comes 75 to 120 feet above the base of the Monongahela series, and ranks next to the Pittsburgh bed in economic importance. Its crop follows closely the region outlined for the crop of the Pittsburgh seam on Map II, or on the average about 100 feet higher in the hills than the latter coal. It attains its best devolpment in the State in Monongalia and Marion counties, often reaching a thickness of over 6 feet; but in Taylor it has thinned away entirely, frequently being represented by only a few inches of black

6. Bull. 65, U. S. Geol. Sur., p. 60; 1891.

slate. Its thickness and relative position in the rock column are exhibited in the general sections for St. Cloud, Mooresville, Behler, Randall and Cassville in Monongalia; and for Glover Gap, Mannington, Farmington, Downs, Worthington, Monongah N W, Iees Run-Fairmont and Monongah S E in Marion. The logs of the several diamond drill holes, published on preceding pages of this chapter give valuable data concerning this seam.

The following is a general section of the bed when possessing its normal thickness of five to six feet:

Coal, upper bench	3′	0″	
Slate, shale or limestone, 1″ to	0	4	
Coal, lower bench	2	8	6′ 0″

Sometimes both benches are again subdivided by one or more thin slates. Thin layers of limestones frequently appear within the body of the bed, revealing the peculiar conditions under which the coal was deposited.

The thickness, character, composition and calorific value of this seam in country banks as well as at commercial mines, will be discussed in detail in a subsequent chapter on the coal resources of the area, along with an estimate of the probable minable area of the bed by magisterial districts.

The Lower Sewickley Sandstone.

Immediately under the Sewickley coal there often occurs a buff, fine grained and massive sandstone, 15 to 30 feet in thickness, that has been named the **Lower Sewickley**[7] from its association with the coal. Its thickness and relative position in the measures are exhibited in the sections for Monongah N W, Tyrconnell and Plummer Knob, and in the record of the Annabelle shaft. It generally forms a bluff around the hillsides immediately below the crop of the Sewickley coal No quarries were observed on this ledge.

7. Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Sur., p. 201; 1912.

Photo by Ray Bricker.

PLATE XVII.—Sewickley Coal, Markley mine, ½ mile east of Osgood, Monongalia County.

The Sewickley Limestone.

The **Sewickley limestone** of J. J. Stevenson comes in the 60-foot interval separating the Sewickley and Redstone coals. It is a hard gray limestone of brackish or fresh water origin, 25 to 50 feet thick including its shale layers. Its thickness and relative position to other formations are exhibited in the general sections for Mooresville and Behler in Monongalia; for Fairview, Downs, Worthington and Monongah N W in Marion; and for Meadland in Taylor. Its crop in the three counties follows closely the area outlined above for the Sewickley coal.

Reger collected a sample for analysis and measured the following section at the exposure of this ledge along the Baltimore & Ohio Railroad grade, 0.2 mile west of Montana Mines, Marion county:

			Feet.	Inches.
1.	Coal, good.....4′ 2″			
2.	Slate, gray.....0 2			
3.	Coal, good, columnar 1 4	Sewickley coal	7	0
4.	Shale, gray.....0 6			
5.	Coal 0 10			
6.	Limestone, gray and hard .....6′ 0″			
7.	Shale, gray and limy 1 0			
8.	Limestone, silicious soft 3 0			
9.	Shale, gray, with limestone nuggets.7 0	Sewickley limestone ..	30	0
10.	Slate, with streaks of coal 0 6			
11.	Slate, black.....0 6			
12.	Shale gray.....1 0			
13.	Limestone, massive, white 4 0			
14.	Shale, gray.....1 0			
15.	Limestone, yellow.6 0			

(Elevation of base of section, 877′ A. T., spirit level).

The composition of the sample from Nos. 6, 13 and 15 only of section, is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	11.02
Ferric Iron (Fe_2O_3)	5.64
Alumina (Al_2O_3)	5.55
Calcium Carbonate ($Ca CO_3$)	53.09
Magnesium Carbonate ($Mg CO_3$)	1.63
Phosphoric Acid (P_2O_5)	0.23
Loss on ignition and undetermined	22.84
Total	100.00

The results show the sample too high in sandy and clayey matter—silica and alumina—for the manufacture of quick or hot limes, but it would burn into a fair agricultural lime and would be adapted to the manufacture of natural cement.

This limestone has been largely replaced by sandy beds and shales in Taylor county. Near the extreme southwest corner of Flemington district, Reger collected a sample of the ledge for analysis and measured the following section at its exposure along the hill road on the head of Bartlett run, 0.2 mile northwest of the common corner to Taylor, Barbour and Harrison counties:

	Thickness. Feet.	Total. Feet.
Sandstone shaly, Upper Sewickley	22	22
Slate, black, 1", Sewickley coal horizon	0	22
Shale, yellow	1	23
Limestone, yellow, good, Sewickley	1	24
Limestone, yellow and brecciated	12	36
Sandstone, shaly, Lower Sewickley	24	60
Shale, sandy	6	66
Concealed	25	91
Sandstone, shaly	2	93
Shale, dark	8	101
Slate, black	3	104
Coal, Pittsburgh (1255' B-A. T.)	7	111

The composition of the sample is reported by Messrs. Hite and Krak as follows under Lab. No. 564 H:

	Per cent.
Silica ($Si O_2$)	21.35
Ferric Iron (Fe_2O_3)	3.69
Alumina Al_2O_3	4.75
Calcium Carbonate ($Ca CO_3$)	65.65
Magnesium Carbonate ($Mg CO_3$)	2.27
Phosphoric Acid (P_2O_5)	0.20
Loss on ignition	1.27
Total	99.18

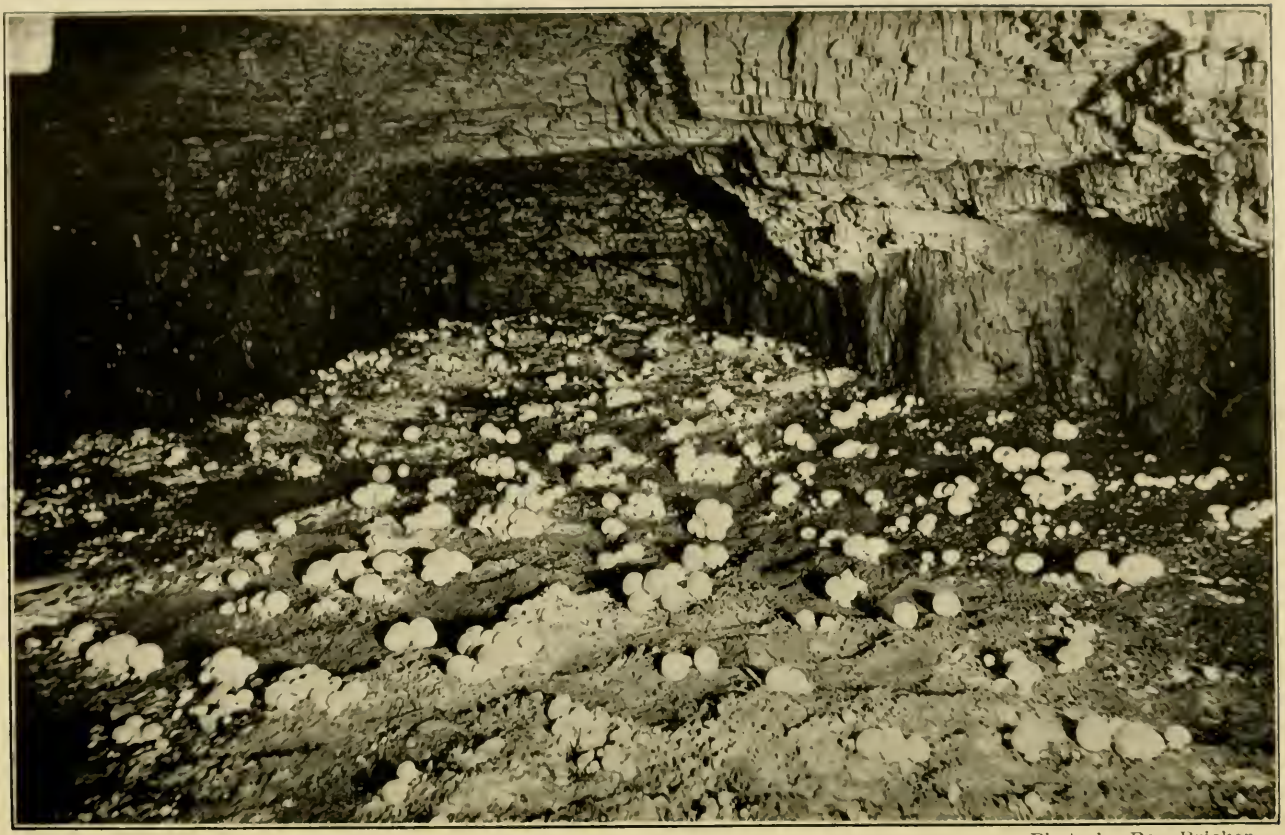

Photo by Ray Bricker.

PLATE XVIII.—Mushroom bed in abandoned Pittsburgh coal mine, West Virginia Experiment Farm, Morgantown.

The results reveal a limestone adapted to the manufacture of agricultural lime and road material.

This limestone not only adds greatly to the fertility of the soil in the area, but it should furnish an abundance of road metal in Cass and Grant districts, Monongalia; and in Pawpaw, Fairmont, Lincoln and Grant districts, Marion county.

The Redstone Coal.

The **Redstone coal** of H. D. Rogers, so designated by the latter from a stream of that name in Fayette county, Pa., belongs 50 to 70 feet below the Sewickley coal and 20 to 40 feet above the Pittsburgh bed. In this area its crop should follow closely the region outlined for the Pittsburgh coal on Map II. Its thickness and relative position to other formations of the Monongahela series are exhibited in the general sections for Mooresville, Behler and Randall in Monongalia; for Ices Run-Fairmont in Marion; and for Webster in Taylor county. Also in the logs published on preceding pages for the following diamond drill borings:

Map No.	Name of Boring	Location	Page
643	Mary Hawkins No. 13	0.6 mile SE of Sturms Mill	223
653	Wm. F. Sandy No. 12	0.5 mile W of Hutchinson	226
672	Shore No. 7	1 mile SW of Barrackville	140

The coal appears to attain minable thickness in a very small portion of the three counties as revealed from crop and the logs of many oil, gas and coal test borings; viz., in the eastern half of Cass and the northeastern corner of Grant district, Monongalia county. Here it sometimes reaches a thickness of 4 to 6 feet. It has been mined on the waters of Scott and Robinson runs by farmers for domestic fuel, giving excellent satisfaction and comparing favorably with the Pittsburgh bed below. All the openings visited had fallen shut so that it was not possible to get a sample for analysis away from its crop; however, Reger collected a sample and measured the following section where the coal had been faced up in a prospect opening on the south hillside of Scott run, one-fourth mile southwest of Randall:

A. H. Tait Prospect, Redstone Coal—No. 15B on Map II.

		Feet.	Inches.
1.	Slate dark.....		
2.	Coal, good.....3′ 1½″		
3.	Slate, black.....0 0¼		
4.	Coal, good.....2 10½	6	0¼

(Elevation, 970′ A. T., aneroid).

"Face of coal cleaned off before taking sample, but some streaks of mud were present in coal owing to its lack of cover."

The compositon of the sample from Nos. 2, 3 and 4 of section, as reported by Messrs. Hite and Krak, is given under No. 15B (Laboratory No. 815H) in the table of coal analyses.

One mile and a quarter southwestward this coal was once mined near the level of a branch of Dents run, on the Martin farm, opposite the residence of S. Z. T. Martin. The opening had fallen shut, but the coal is reported 4 to 5 feet thick and of fine quality.

Slightly over two miles southwestward the Redstone coal is reported absent in the Frank Brand coal test boring (315), 1 mile westward from Laurel Point.

The probable minable area of the bed will be discussed in detail in a subsequent chapter.

The Redstone Limestone.

The 20 to 40 feet of interval between the Redstone and Pittsburgh coals generally carries a calcareous stratum, 5 to 15 feet in thickness, that has been named by Messrs. Platt the **Redstone limestone** from its association with the overlying coal. Its crop in the three counties follows closely the area outlined for the crop of the Pittsburgh coal on Map II. It is dark gray in color on fresh fracture, but weathers to a yellowish gray. The limestone is of brackish or fresh water origin as revealed by the fresh water fossils therein. Its thickness and relative position in the rock column are exhibited in the general sections for Mooresville, Behler and Randall in Monongalia; for Ices Run-Fairmont and Monongah S E in Marion; and for Webster in Taylor county.

The following interesting data concerning the thickness,

character, composition and uses of the Redstone limestone at its crop on Scott run, Cass district, Monongalia county, near the old Tait mine in the Pittsburgh coal, along with the Uniontown and Sewickley limestone cropping above, is taken from pages 529 and 530 of Vol. III of the State Survey reports:

"The Pittsburgh coal is mined a short distance up the creek and underlies nearly all this region. Ten to twelve feet above the coal is the Redstone limestone 18 feet in thickness, with the Redstone coal above and 75 to 100 feet higher is a series of limestone layers separated by shales about 100 feet in thickness, known as the Uniontown limestone.

"Over the Redstone coal is a fine shale 15 to 20 feet in thickness, and then 6 feet of limestone. In this area are shales, limestone and coal. While the Redstone limestone is not very thick (18 feet) it outcrops around the hills over a large acreage, so that the quantity would be large, and followed around these hills the cover would not be too heavy for profitable quarrying.

"The chemical composition of these limestones is shown by the following analyses:

	No. 122	No. 125	No. 126
Lime carbonate	79.63	86.70	83.52
Magnesium carbonate	1.44	5.32	3.78
Silica	12.21	5.96	10.54
Alumina	2.87	1.01	0.75
Iron oxide	2.36	1.27	2.06
Titanium	0.15	0.07	0.05
Totals	98.66	100.33	100.70

"No. 122 is the Redstone limestone.

"No. 125 is near the top of the Uniontown limestone.

"No. 126 is the 6 to 8 foot limestone (Sewickley) above Redstone coal.

"A mill could be built near the river and the cement loaded directly into boats or an overhead cable carry the cement across the river to the Baltimore & Ohio Railroad.

"For fuel, the Pittsburgh coal could be mined by drift or shaft over the whole area, the other coals would be available as fuel for power."

It might be added that since the above was written by G. P. Grimsley in 1906 the Buckhannon & Northern Branch of the Pittsburgh & Lake Erie Railroad has been completed on the west side of the river, thus furnishing additional transportation facilities.

In **Taylor county** this limestone does not appear so thick as in Monongalia and Marion. In Courthouse district, slightly over a mile south of Webster, Reger collected a sample of this ledge for analysis and measured the following hand-leveled section:

		Thickness. Feet.	Total. Feet.
1.	Coal streak, Redstone	0	0
2.	Limestone, yellow, Redstone	1	1
3.	Concealed	23	24
4.	Slate	4	28
5.	Coal, Pittsburgh (1435' L.A. T.)	9	37

The composition of the sample from No. 2 of section is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	9.15
Ferric Iron (Fe_2O_3)	3.53
Alumina (Al_2O_3)	1.35
Calcium Carbonate ($Ca CO_3$)	71.73
Magnesium Carbonate ($Mg CO_3$)	11.51
Phosphoric Acid (P_2O_5)	0.14
Loss on ignition	2.20
Total	99.61

The results reveal a magnesian limestone adapted to the manufacture of natural cement, but too high in sandy and clayey matter for the lime of commerce.

This limestone adds greatly to the fertility of the soil wherever it crops above drainage and it should furnish an abundant supply of road metal in Cass and Grant districts, Monongalia; in Pawpaw, Fairmont, Lincoln and Grant districts, Marion; and in Flemington and Courthouse districts, Taylor county.

The Upper Pittsburgh Sandstone.

The Upper Pittsburgh sandstone, coming immediately over the Pittsburgh coal, was so named by H. D. Rogers from its association with the latter bed. Its horizon should crop over about the same area as that outlined for the Pittsburgh coal on Map II. It is an old shore deposit and attains its best development on the east side of the Monongahela river, being largely replaced by limestones on the west side of the latter stream. Its thickness and relative position to other formations are exhibited in the general sections for Morgan Run, Easton, Morgantown and Beechwood in Monongalia; and for Farmington, Ices Run-Fairmont and Monongah S E in Marion county. Also in the log of the Jamison No. 7 shaft, page 230.

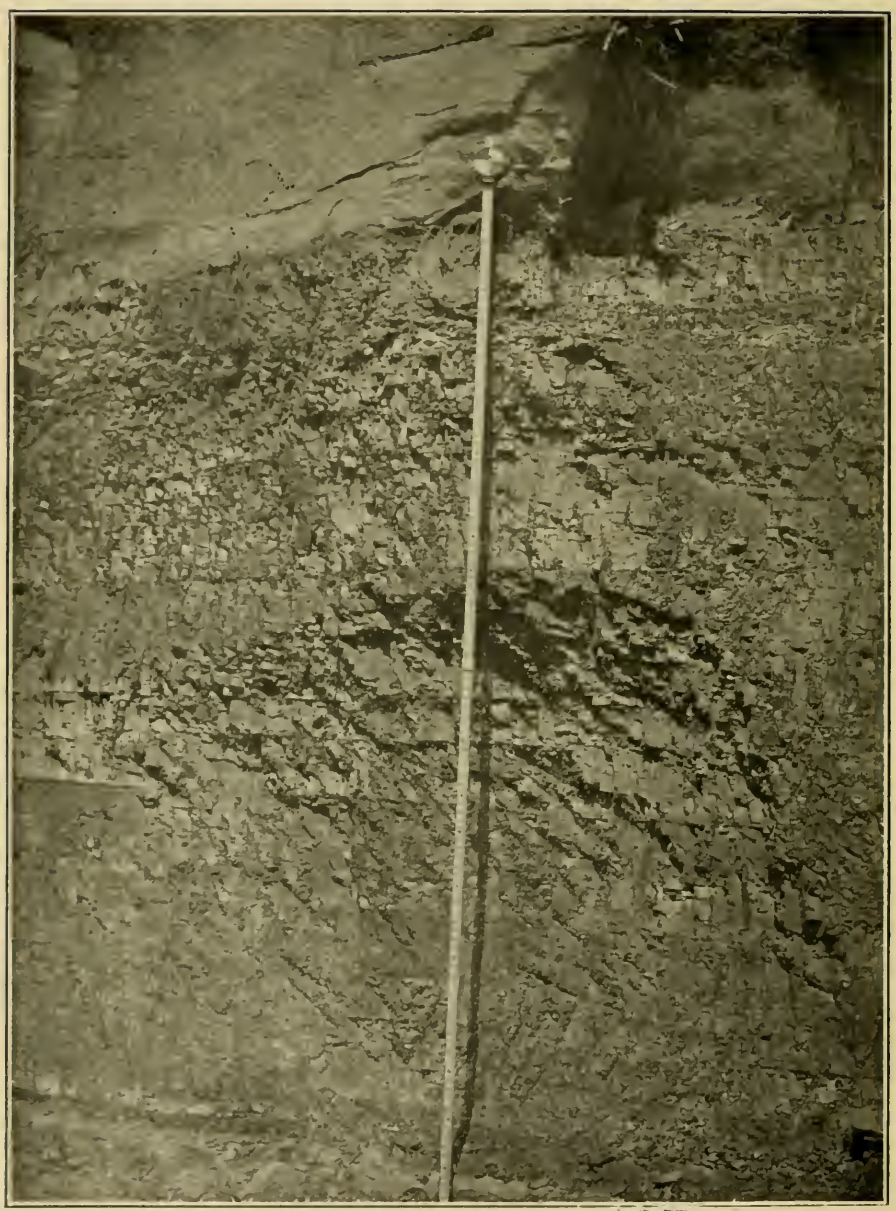

Photo by Ray Bricker.

PLATE XIX.—Pittsburgh Coal exposure in Monongahela River hill opposite Round Bottom, Monongalia County.

In eastern Monongalia and Marion, where it is well developed, it is usually a massive, coarse, gray, arenaceous stratum, containing much feldspathic material, and easily disintegrating into coarse sand where exposed to the atmosphere. It has been quarried frequently for building purposes in the Fairmont region of Marion county, but its easily weathering properties render it unsatisfactory for exposed work. It is this stratum that is quarried ¼ mile northwest of the Fairmont Fairground at an elevation of 1070′ A.T., aneroid, where the following section was measured by Reger:

	Feet.
Sandstone, shaly	7
Sandstone, massive	16
Shale	4
Coal ,Pittsburgh	8

It is also this sandstone that is quarried along the hill road, 0.9 mile southeast of the Baltimore & Ohio Railroad station at Fairmont, where it is 25 feet thick, massive, coarse, gray and soft, coming directly over the Pittsburgh coal.

The Pittsburgh Coal.

The basal formation of the Monongahela series is the **Pittsburgh coal bed,** so named by J. P. Lesley in 1856 from the city of Pittsburgh, Pa., where it crops high up in the river hills. I. C. White gives an interesting account of this great coal seam and its influence on the industrial growth of northern West Virginia and the city of Pittsburgh, on page 164 of Vol. II of the State Survey reports.

In the western portions of Monongalia and Marion counties this coal lies from 300 to 800 feet below drainage, but in the districts fronting on the Monongahela and West Fork rivers, it comes to the surface. A small area of this bed is caught in the Ligonier Basin, southwest from Pruntytown in Taylor county. The detailed crop of the coal is shown on Map II.

As mentioned on preceding pages, this bed is largely used as a key rock by oil and gas well drillers to determine the position of the oil and gas bearing sands. Map II exhib-

its by means of contour lines, printed in green, the elevation above mean tide of the top of the horizon of this coal in every portion of the area, even where the seam has been entirely eroded. This map also shows the accurate location of the oil and gas wells, dry holes and coal test borings, a large number of which have been given the same serial number for reference purposes both on the map and in the text of this report. The reader is referred to these numbered wells in the table for each county given on subsequent pages for a large fund of information concerning Pittsburgh coal.

In every portion of the area, wherever not removed by erosion, this bed appears to attain minable thickness and regularity.

J. J. Stevenson first described the detailed structure of the coal in Report K of the Second Geological Survey of Pa., where he shows that a series of thin parting clays and slates subdivide the seam into several distinct portions as follows:

1. Roof coals.
2. Over clay.
3. Breast coal.
4. Parting.
5. Bearing-in coal.
6. Parting.
7. Brick coal.
8. Parting.
9. Bottom coal.

A description of the character and thickness of these separate parts is given on pages 166-172 of Vol. II of the State Survey reports by I. C. White.

At present there are 55 to 60 commercial mines in the Pittsburgh coal in the three counties. With the exception of seven shaft operations in Marion, all are driven directly on the crop of the coal or by slope. The following is a general type section of the coal as exhibited at these mines:

		Feet.	Inches.
1.	Draw slate.....		
2.	Breast coal { top coal bony..1′ 0″ / coal 2 6	3	6
3.	Bands { bone .....0′ 0¾″ / coal .....0 6 / bone 0 0¾	0	7½
4.	Bottom coal	4	6
	Total	8	7½

The "roof coals" of Stevenson are not always present, but the other divisions are generally represented.

The thickness, character, composition, and calorific value of the coal at the several commercial mines as well as some local country banks, will be discussed fully in a subsequent chapter, along with an estimate of the probable available area and tonnage of the bed by magisterial districts.

CHAPTER VII.

STRATIGRAPHY—CONEMAUGH SERIES.

The Conemaugh series is limited to that division of the rock column that begins at base with the top of the Upper Freeport coal and extends up to the base of the Pittsburgh coal. I. C. White gives an interesting account of this series in West Virginia on pages 225-226 of Vol. II of the State Survey reports.

Map II shows the detailed crop of these rocks, and a glance at the same will show that they rank next to the Dunkard in area exposed. The thickness ranges from 550 feet in western Monongalia to 600 feet along the Monongahela river in the latter county.

SECTIONS.

The following general section of the Conemaugh in West Virginia with some slight modifications is as published by the writer on pages 220-221 of the Doddridge-Harrison Report:

General Section of the Conemaugh Series in West Virginia.

	Thickness. Feet.	Total. Feet.	
Fire clay and shale	5	5	
Sandstone massive, Lower Pittsburgh	35	40	
Shale, gray	3	43	
Limestone, Upper Pittsburgh	4	47	
Coal, Little Pittsburgh	1	48	48′
Fire clay and gray shale	7	55	
Limestone, Lower Pittsburgh	10	65	
Shale, sandy and red	40	105	
Sandstone, massive, brown, pebbly, Connellsville	30	135	
Coal, Little Clarksburg	1	136	88′
Fire clay shale, Clarksburg	5	141	

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, mottled with peroxide of iron, lenticular, quarried at Morgantown, Lower Connellsville	20	161	
Limestone, gray and hard, Clarksburg, 5′ to	15	176	
Shale, sandy and red, Clarksburg Reds	37	213	
Sandstone, massive, Morgantown	40	253	
Coal Elk Lick	2	255	119′
Fire clay and shale	9	264	
Lime, dark gray, Elk Lick	5	269	
Coal, West Milford (2″) to	1	270	
Shale, sandy and red, Birmingham	10	280	
Sandstone, massive, pebbly, lenticular, Grafton	20	300	
Limestone, marine fossils, Upper Ames	4	304	
Shale, dark green, marine fossils, Ames	15	319	
Limestone, marine fossils, Lower Ames	3	322	
Shale, dark	6	328	
Coal, Harlem	2	330	75′
Fire clay and red shale	10	340	
Limestone, gray, Ewing	5	345	
Red shale, "Pittsburgh Reds"	40	385	
Sandstone, massive, Saltsburg	30	415	
Coal, Bakerstown	2	417	87′
Fire clay shale	5	422	
Limestone, marine fossils, Pine Creek	1	423	
Shale, 5′ to	21	444	
Sandstone, massive, gray and white, pebbly Buffalo	60	504	
Limestone, marine fossils, Brush Creek ,1′ to	5	509	
Shale, black, marine and plant fossils, Brush Creek, 5′ to	10	519	
Coal, Brush Creek	1	520	103′
Fire clay shale with layers of ferriferous limestone, Brush Creek	4	524	
Sandstone, massive, Upper Mahoning	15	549	
Coal, not persistent, Mahoning, 0′ to	1	550	30′
Fire clay, good, not persistent, Thornton, 0′ to	5	555	
Sandstone, Lower Mahoning	40	595	
Shale, dark sandy, plant fossils, Uffington	5	600	50′
Coal, Upper Freeport.			

Several sections, published in Chapter IV, exhibit the succession and character of the strata of the Conemaugh series in the area, and five other widely separated sections as exposed at crop will now be given:

MONONGALIA COUNTY.—The following section was measured in the northwest portion of Morgan district with hand-level southward down the river hill from the O. H. Dille sandstone quarry in the Lower Connellsville ledge and connected with the top of the Jos. Krepps No. 1 well (320A) opposite Mona (Granville):

Section 0.8 Mile E of Mona, Conemaugh Series.

	Thickness. Feet.	Total. Feet.	
Shale, sandy	2.7	2.7	
Shale, bituminous (Little Clarksburg coal horizon)	0.3	3	3′
Fire clay shale	1	4	
Sandstone, shaly and green	6	10	
Sandstone, massive, coarse, brown, mottled heavily in upper portion with peroxide of iron, quarry ledge, Lower Connellvsile	11	21	18′
Limestone, gray and hard, silicious, Clarksburg	1.5	22.5	
Shale, variegated, with layers of limestone	20	42.5	
Limestone, dark gray and hard, nodular	2	44.5	
Shale, limy and variegated, with concretions of ferriferous limestone at bottom	25	69.5	
Sandstone, shaly, Morgantown, and concealed	18	87.5	
Coal (20″) Elk Lick	1.5	89	68′
Concealed and limestone, Lower Ames	85	174	
Concealed to Jos. Krepps No. 1 well (320 A)	64	238	149′

This is an important section in that—in connection with the one for Morgantown in Chapter IV—it shows the quarry rock belonging between the Little Clarksburg coal horizon and the Clarksburg limestone, 20 feet below the true Connellsville sandstone; hence, it has been designated by the writer the **Lower Connellsville.**

The following section of the upper portion of the Conemaugh is obtained in the northern edge of Union district, one-third mile southward from Cheat Haven, by combining a spirit level section measured down the east hillside of Cheat to the State Line Dam, with the log of a diamond drill boring (328) kindly furnished by the Mt. Park Land Co.:

Cheat Haven Dam Section.—Conemaugh Series.

	Thickness Ft.	In.	Total, Ft.	In.	Tidal Elevation of base.
Coal, Pittsburgh	8	0	8	0	1062.0
Conemaugh Series:					
Unrecorded	187	0	195	0	875.0
Shale, broken and sandy	27	0	222	0	848.0
Shale, sandy	2	6	224	6	845.5
Shale	4	6	229	0	841.0
Fire clay	1	0	230	0	840.0
Slate	1	0	231	0	839.0

	Thickness. Ft.	In.	Total. Ft.	In.	Tidal Elevation of base.
Coal, Elk Lick	1	0	232	0	838.0
Limestone, Elk Lick	6	0	238	0	832.0
Fire clay	11	0	249	0	821.0
Sandstone	2	0	251	0	819.0
Shale, hard, sandy	6	6	257	6	812.5
Shale	5	0	262	6	807.5
Concealed, surface debris	11	0	273	6	796.5
Shale, fire clay and loam	5	3	278	9	791.2
Shale, or hard yellow fire clay	3	4	282	1	787.9
Bore Hole No. 1 Record					
Gravel wash from top	15	6	297	7	772.4
Fire clay wash	2	6	300	1	770.2
Shale, dark gray, medium hard	10	4	310	5	759.9
Shale, dark gray, marine fossils..3' 2" / Limestone, dark gray .....0 6 / Shale, black, marine fossils.....3 0 (Lower Ames)	6	8	317	1	753.2
Coal, Harlem	0	4	317	5	752.9
Fire clay shale, gray	10	0	327	5	742.9
Shale, red and variegated, Pittsburgh Reds	18	6	345	11	724.4
Shale, gray	2	6	348	5	721.9
Shale, greenish gray, silicious and hard	5	0	353	5	716.9
Sandstone, fine grained, micaceuos, light gray and hard, Saltsburg	9	3	362	8	707.6
Shale, sandy and limy, greenish	4	0	366	8	703.6
Shale, variegated, with tinge of red to bottom of hole	15	9	382	5	687.9

The following section was measured with hand-level by Reger along the southeast border of Grant district southeastward down the river hill from the crop of the Pittsburgh coal to the Monongahela river opposite Round Bottom:

Round Bottom Section, Conemaugh Series.

	Thickness. Feet.	Total. Feet.
Shale, gray	2	2
Concealed	37	39
Shale, black, streak	0	39
Limestone, shaly, Lower Pittsburgh	7	46
Sandstone, light brown, fine grained, hard	15	61
Concealed	9	70
Sandstone, brown, flaggy, fine, Connellsville	22	92
Concealed	18	110
Sandstone, massive	4	114
Concealed and shale, yellow	16	130
Concealed	33	163

	Thickness. Feet.	Total. Feet.	
Coal, very slaty, Elk Lick	1	164	164′
Concealed	35	199	
Sandstone, hard, brown, massive, pebbly, Grafton	28	227	
Concealed	5	232	
Sandstone, shaly	2	234	
Shale, green	20	254	
Limestone, shaly, fossiliferous, Ames	5	259	
Coal, Harlem (855′ L-A. T.)	1	260	96′
Shale, red, Pittsburgh, and concealed to river (Pool No. 11)	38	298	38′

In the above section intervals and thicknesses of formations above the Elk Lick coal are much less than they should be owing to the rapid rise of the strata in the direction of measurement.

MARION COUNTY.—The following partial section of these beds was measured with hand-level by Reger southeastward from the Pittsburgh coal to the river, 0.2 mile northeast of the Baltimore & Ohio R. R. station at Fairmont:

Fairmont Section, Conemaugh Series.

	Thickness. Feet.	Total. Feet.
Shale, very silicious, with iron ore nuggets	22	22
Sandstone, massive, white, soft, Lower Pittsburgh	16	38
Shale, gray, limy	9	47
Coal, slaty, Little Pittsburgh	0.5	47.5
Shale, limy, gray	23.5	71
Shale, dark	5	76
Limestone, massive, Lower Pittsburgh	6	81
Concealed to river	22	103

TAYLOR COUNTY.—In the western portion of Booths Creek district the following section was measured with aneroid southeastward along the hill road to Carder run at Hepzibah:

Hepzibah Section, Conemaugh Series.

	Thickness. Feet.	Total. Feet.	
Sandstone, massive, coarse, pebbly, Grafton, from summit of hill road	25	25	
Shale, dark green, marine fossils, Ames	9.5	34.5	
Coal 0′ 9″ / Slate, gray 0 1 / Coal 0 8 — Harlem coal. (1320′ B-A. T.)	1.5	36	36′

	Thickness. Feet. In.	Total. Feet. In.	
Shale, red, Pittsburgh	20	56	
Shale, buff, sandy, yellowish	10	66	
Sandstone, shaly	5	71	
Concealed and red shale	15	86	
Shale, sandy	10	96	
Concealed	5	101	65′
Fire clay shale	5	106	
Shale, buff, sandy	5	111	
Red shale	20	131	
Concealed	20	151	
Black slaty blossom	0	151	
Concealed to Carder run at Hepzibah	50	201	100′

The following section was measured with aneroid in the central portion of Knottsville district westward along the hill road to Knottsville:

Knottsville Section, Conemaugh Series.

	Thickness. Feet.	Total. Feet.
Sandstone, massive, Connellsville	35	35
Concealed	10	45
Shale, buff and sandy	10	55
Concealed	25	80
Shale, buff	20	100
Concealed	20	120
Shale, yellowish	15	135
Shale, red	30	165
Shale, buff and sandy	15	180
Concealed to cross-roads, Knottsville	35	215

(Base of section, 1484′ A. T., spirit level).

The base of the section comes only a few feet—5′ to 15′—above the Elk Lick coal the blossom of which shows along the highway, 0.4 mile southeast of the town. Owing to the rapid dip of the strata in the direction the section was measured, intervals are greater than they should be.

DESCRIPTION OF CONEMAUGH FORMATIONS.

The Lower Pittsburgh Sandstone.

The highest formation yet described in the Conemaugh measures is the **Lower Pittsburgh sandstone,** belonging at 5 to 10 feet below the Pittsburgh coal. When normal it is a

massive bluish gray rock, micaceous and medium grained, ranging in thickness from 5 to 25 feet. Its thickness and relative position to other formations are exhibited in the sections for Randall, VanVoorhis and Morgantown in Monongalia; for Fairmont in Marion; and for Flemington and Thornton in Taylor.

It is this stratum that is quarried on the J. W. Holland farm in the northeast corner of Grant district, Monongalia, 0.4 mile northeast of the J. W. Holland No. 1 well (317), where the following section is exposed:

	Ft.	In.
Sandstone, shaly	6	0
Sandstone, hard, bluish gray, micaceous and medium grained, quarry rock	11	0
Concealed		
(Elevation of sandstone, 960′ B-A. T.)		

The face of the quarry is 11 feet high, 75 to 100 feet long, and is worked back 10 to 15 feet into the hill.

No other quarries were observed on this ledge.

The **Upper Pittsburgh limestone** of White[1], belonging 30 to 40 feet below the Pittsburgh coal and immediately above the Little Pittsburgh coal, was not observed. In the several sections measured its horizon was generally concealed.

The Little Pittsburgh Coal.

At 40 to 50 feet below the Pittsburgh coal and between the Upper and Lower Pittsburgh limestones there frequently occurs a thin—10 to 18 inches—double-bedded coal that has been named the **Little Pittsburgh**[2] from its association with the thicker vein above. Its thickness and relative position in the rock column are exhibited in the sections for Randall, Cassville, Beechwood and VanVoorhis in Monongalia; for Fairmont in Marion; and for Meadland in Taylor.

The following section was measured at its crop near the J. W. Holland No. 1 well (317) in northern Grant district, Monongalia, 1.4 miles northeast of Laurel Point:

1. I. C. White, Vol. II, W. Va. Geol. Survey, p. 245; 1903.
2. I. C. White, Vol. II, W. Va. Geol. Survey, p 245; 1903.

	Ft.	In.
Coal, Pittsburgh	10	0
Concealed	24	0
Coal .....0′ 11 ″		
Slate, gray....0 2½ } Little Pittsburgh coal..	1	11
Coal .....0 9½] (955′ B- A. T.)		
Shale	2	0
Concealed	6	0
Limestone, dark gray, many fossil spiroribis and other minute forms, Lower Pittsburgh	7	0
Concealed to top Holland well (317)	14	0

Reger reports this coal 2 feet thick at an elevation of 960′ A.T., aneroid, directly over 10 feet of hard limestone, along the highway in southern Grant district, Marion county, 0.5 mile north of Eldora.

In Taylor this coal is 12 inches thick where it crops in the road, 1 mile northwest of Pruntytown, coming there 45 feet below the Pittsburgh bed at an elevation of 1415′ A.T., aneroid.

The vein is too thin and irregular to be mined successfully.

The Lower Pittsburgh Limestone.

The **Lower Pittsburgh limestone** of White[3] belongs 50 to 60 feet below the Pittsburgh coal and 1 to 5 feet below the Little Pittsburgh bed. Its thickness and relative position to other formations are exhibited in the sections for Randall in Monongalia, and for Fairmont in Marion. It is generally 5 to 10 feet in thickness, dark gray in color, carrying many minutes Spiroribis fossils and other fresh water forms. The above section under the account of the Little Pittsburgh coal shows 7 feet of this ledge in northern Grant district, Monongalia.

This limestone is quite generally present in good thickness wherever its horizon crops, which follows closely the area outlined for the Pittsburgh coal on Map II; hence, it should furnish an abundance of fairly good road metal for the magisterial districts adjoining the Monongahela and West Fork rivers.

3. I. C. White, Vol. II, W. Va. Geol. Survey, p. 245; 1903.

The Connellsville Sandstone.

The **Connellsville sandstone** of J. J. Stevenson belongs 75 to 100 feet below the top of the Conemaugh series, and was so named from its crop near the town of Connellsville, Pa. It is coarse, brown, massive, often pebbly and 15 to 40 thick. On pages 247-248 of Vol. II of the State Survey reports, I. C. White gives an account of this ledge in West Virginia. Its thickness and relative position to other formations are exhibited in the sections for Randall, Beechwood, Morgantown, VanVoorhis, Little Falls and Round Bottom in Monongalia county; for Glover Gap and Downs in Marion; and for Webster, Thornton, Stonehouse, Cecil and Knottsville in Taylor.

The high grade building stone from the Cox (formerly Lowe and Dille) quarries at Morgantown was placed at this horizon in Vol. II above mentioned, but the sections for Mona and Morgantown show the quarry rock representing a separate formation, 20 to 30 feet lower in the measures. However, the true Connellsville sandstone has been quarried to a small extent on the north hillside of Falling run at Morgantown at an elevation of 1110′ A.T., aneroid, where it is coarse and grayish brown, furnishing a fair grade of building stone.

This ledge was once quarried in conjunction with the Lower Connellsville along the northeast hillside of the Monongahela river, 0.3 miles southeast of Beechwood, Monongalia county, where the following section was measured with hand-level by Reger:

	Thickness. Feet.	Total. Feet.
Coal, Pittsburgh	9	9
Concealed	52	61
Coal, slaty, Little Pittsburgh	1	62
Shale	7	69
Sandstone, massive, hard, Connellsville	33	102
Shale, dark (Little Clarksburg coal horizon)	1	103
Shale, gray and limy	10	113
Iron ore	0.5	113.5
Sandstone, shaly	1.5	115
Sandstone, massive, Lower Connellsville	28	143
Shale, gray	1	144
Slate, black	1	145
Limestone, hard, Clarksburg	1	146
Concealed to river, Pool No. 13	94	240

No other quarries were observed on this ledge.

The Little Clarksburg Coal.

The **Little Clarksburg coal** of White[4], belonging 110 to 130 feet below the top of the Conemaugh series and at the base of the Connellsville sandstone, is a thin—10 to 15 inches—double-bedded seam of rather wide persistence but of no present economic value. Its thickness and relative position in the rock column are exhibited in the sections for Randall and Mona in Monongalia; and for Meadland, Flemington and Thornton in Taylor. The following section measured at its crop on Stewart street, Morgantown, shows its structure when normal:

		Ft.	In.
1.	Shale		
2.	Coal 0′ 10″		
3.	Shale, gray 0 1 } Little Clarksburg	1	3
4.	Coal 0 4		
5.	Fire clay shale		

(Elevation, 1125′ A. T., aneroid).

It crops along the road one-fourth mile southeast of Easton, Monongalia, at an elevation of 1025′ A.T., aneroid, with a thickness of 18 inches, 120 feet below the Pittsburgh coal.

In Taylor county Reger collected a sample of this coal for analysis and measured the following section at its crop on the north side of the B. & O. R. R. in Flemington:

1.	Sandstone, massive, Connellsville	18′	0″
2.	Coal, slaty 0′ 5″		
3.	Coal, good 1 0 Little Clarksburg.	1	5
4.	Shale, gray	6	0
5.	Limestone, good, Clarksburg	3	0

(Elevation of coal 1060′ B-A. T.)

The **composition** and **calorific value** of the sample from No. 3 only of section are given under No. 69 (Laboratory No. 563H) in the table of coal analyses.

The Lower Connellsville Sandstone.

In the interval separating the Little Clarksburg coal and

4. I. C. White, Bull. 65, U. S. G. Survey, p. 88; 1891.

the Clarksburg limestone there sometimes occurs a massive, coarse, brown and arenaceous stratum, mottled with brown specks of peroxide of iron, 10 to 20 feet thick, that has long been quarried for building purposes in the vicinity of Morgantown. Here its thickness and relative position in the rock column at the Cox quarry are exhibited in the Morgantown section; and for the O. H. Dille quarry, in the Mona section. It is one of the finest building stones in the State on account of its durable qualities and reddish brown color. For all structures like bridge piers and outside walls it has no superior, due to its resistance to weathering. The old suspension bridge piers at Morgantown as well as the present post office building were built of stone from this ledge.

It is this sandstone that is quarried on the John D. Anderson land just east of the Kingwood pike, 1 mile southeast of Morgantown, where the following section was measured:

	Ft.	In.
Shale, sandy and reddish	15	0
Sandstone, shaly	3	0
Sandstone, massive, pebbly, mottled with brown peroxide of iron, Lower Connellsville	15	0

(Elevation of quarry, 1100′ A. T., aneroid).

The stone from this quarry is hauled to Morgantown for general building purposes, and some was used in the construction of the wall around the Second Ward school building

This formation does not appear very persistent, being more or less lenticular, since it was observed at only two other points away from the immediate Morgantown region. One of these was at the quarry near Beechwood, mentioned above under the description of the Connellsville sandstone; and the other, near the summit of the river hill, 0.5 mile northeast of Little Falls station (See Little Falls section).

The Clarksburg Limestone.

From a few inches to 20 feet below the Little Clarksburg coal there occurs a dark gray calcareous formation, 10 to 30 feet thick, that has been designated the **Clarksburg limestone**[5]

5. I. C. White, Bull. No. 65, U. S. G. Survey, p. 88; 1891.

from its crop in the town of that name in Harrison county. Its thickness and relative position in the rock column are exhibited in the sections for Randall and Mona in Monongalia, and for Meadland in Taylor. The approximate position of its crop around the hillsides can be determined readily by subtracting 150 feet from the elevation of the Pittsburgh coal as shown on Map II.

In Monongalia county, the following section was measured at the crop of this limestone in the old shale pit of the Randall Brick Co. in the north edge of Star City:

	Ft.	In.
Concealed	5′	0″
Shale, black	3	0
Limestone, dark gray, ferriferous and fossiliferous, Clarksburg	6	0
Shale, red and variegated, Clarksburg	25	0

(Elevation of limestone, 880′ B-A. T.)

In the southern border of Grant district, same county, Reger measured the following section at its crop on the west hillside of the Monongahela river opposite Opekiska:

		Feet.
Sandstone, Connellsville		
Concealed		25
Limestone, hard....6′		
Shale, limy....7		
Limestone, hard....2	**Clarksburg Limestone**	24
Shale, limy....3		
Limestone, hard....6		

(Elevation of base of limestone, 870′ B- A. T.)

In Winfield district, Marion, 5 feet of this ledge is visible in the public road, 0.8 mile southeast of Catawba, at an elevation of 1240′ A.T., aneroid.

In the southern edge of Grant district, same county, this limestone crops along the road, 1 mile northeast of Boothsville, at an elevation of 1230′ A.T., aneroid, where the following section is exposed:

	Ft.	In.
Shale, sandy	10	0
Shale, dark, coaly, Little Clarksburg	0	10
Fire clay shale	1	0
Limestone, dark gray, hard, Clarksburg	4	0

In the eastern border of Flemington district, Taylor, Reger collected a sample of this ledge for analysis and measured the following section on the east bank of Berry run in the north edge of Flemington:

	Feet.
Sandstone, massive, Connellsville	20
Limestone, dark gray, Clarksburg	4
Concealed	
(Elevation of limestone, 1040′ B-A. T.)	

The composition of the sample is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	3.45
Ferric Iron (Fe_2O_3)	1.62
Alumina (Al_2O_3)	0.57
Calcium Carbonate ($Ca CO_3$)	83.13
Magnesium Carbonate ($Mg CO_3$)	8.35
Phosphoric Acid (P_2O_5)	0.19
Loss on ignition	1.70
Total	99.01

One mile and a half southward this formation was once quarried to burn into agricultural lime. Here, Reger collected another sample for analysis and measured the following section at the quarry face:

		Feet.
1.	Sandstone, massive, brown and pebbly, Connellsville	20
2.	Concealed	8
3.	Limestone, good, Clarksburg	4
4.	Shale, gray	3
5.	Shale, with limestone boulders	15
(Elevation of limestone (No. 3), 1025′ A. T., aneroid).		

The composition of the sample is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	3.65
Ferric Iron (Fe_2O_3)	2.17
Alumina (Al_2O_3)	0.41
Calcium Carbonate ($Ca CO_3$)	82.34
Magnesium Carbonate ($MgCO_3$)	9.18
Phosphoric Acid (P_2O_5)	0.20
Loss on ignition	1.57
Total	99.52

In Courthouse district, same county, this formation crops along a Baltimore & Ohio R. R. cut, one-fourth mile west of Bryden, where it is separated into two separate ledges, and there Reger collected samples for analysis and measured the following section:

		Ft.	In.
1.	Sandstone, gray hard, massive, Connellsville.	25	0
2.	Coal, Little Clarksburg	0	6
3.	Shale, gray	2	6
4.	Limestone, good..... 4' ⎫ Clarksburg		
5.	Shale, red.....15 ⎬ Limestone	25	0
6.	Limestone, good..... 6 ⎭		
7.	Shale, gray	3	0

(Elevation of limestone, 1130 B-A. T.)

The composition of the samples collected separately from **No. 4, No. 5,** and **No. 6** of the section is reported as follows by Messrs. Hite and Krak under Lab. Nos. 566H, 567H and 568H, respectively:

	No. 4	No. 5	No. 6
Silica ($Si O_2$)	16.82	55.88	9.96
Ferric Iron (Fe_2O_3)	7.17	8.17	4.12
Alumina (Al_2O_3)	4.44	21.71	2.34
Calcium Carbonate ($Ca CO_3$)	51.57	.....	73.34
Magnesium Carbonate ($Mg CO_3$)	14.66	.....	7.89
Phosphoric Acid (P_2O_5)	0.45	0.25	0.36
Lime (Ca O)	.....	0.75	.....
Magnesia (Mg O)	.....	1.95	.....
Soda (Na_2O)	.....	0.56	.....
Potassa (K_2O)	.....	3.44	.....
Titanium ($Ti O_2$)	.....	0.32	.....
Moisture	.....	0.90	.....
Loss on ignition	4.28	6.39	1.54
Totals	99.39	100.32	99.55

The above limestone analyses (Nos. 4 and 6) show these ledges to be adapted to the manufacture of natural cement, agricultural lime, and road material.

The results of analysis No. 5 show the red shale to be adapted to the manufacture of building brick with a deep red color, due to the high ferric iron content.

The **Clarksburg red shale**[6] was observed at one or two localities in the area, and is noted in the sections for Thorn-

6. Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Sur., p. 240; 1912.

ton and Cecil. It was also used by the Randall Brick Co. at Star City to manufacture brick, as shown in the section given above under the account of the Clarksburg limestone.

The Morgantown Sandstone.

At 40 to 50 feet below the Clarksburg limestone at Morgantown there occurs a massive, arenaceous stratum, 20 to 40 feet thick, named the **Morgantown sandstone** by J. J. Stevenson. It has been quarried there quite extensively for the construction of the State University buildings and other structures, concerning which I. C. White gives the following on page 250 of Vol. II of the State Survey reports:

"At this typical locality the top of the sandstone lies a little more than 200 feet below the Pittsburgh coal, and the stratum has a thickness of twenty-five feet. It is usually of a yellowish gray cast, and splits readily into building blocks of any desired size. The rock contains much feldspathic material, and occasionally some lime, and in weathering the rock changes from a bluish gray cast to a dirty brown, and frequently decomposes readily, so that as a building stone for exposed surfaces, it is not a success, some of the stone work at the State University at Morgantown having disintegrated badly within a period of twenty-five years.

"Several of the locks along the Monongahela river, between Morgantown and Pittsburgh, have been constructed of this stone, and the dinistegration of the lock walls is a constant source of expense."

Its thickness and relative position to other formations are exhibited in the sections for Beechwood, VanVoorhis, Morgan Run, Easton, and Mona in Monongalia; and for Flemington and Cecil in Taylor. It crops over practically the same area as that outlined above for the Clarksburg limestone, and generally forms a steep bluff or slope around the hillsides. This sandstone forms the great cliffs in the northeast corner of Cass district, Monongalia, on Crooked run; also along the west hillside of the Monongahela between Maidsville Landing and VanVoorhis. It is a prominent cliff former along the same stream between Morgantown and Fairmont.

It is this formation that is quarried on the Lowry Smith farm on the north bank of Robinson run, 0.2 mile north of Maidsville Landing, where the following section was measured:

		Feet.
1. Sandstone, massive, bluish gray.....15′ 2. Sandstone, flaggy, to base of quarry.....10	Morgantown	25
3. Concealed to Robinson run.....		15

(Elevation of quarry, 825′ A. T., aneroid).

The face of the quarry is 60 feet long and has been worked back into the hill 15 feet. The stone is used for house foundations and for culverts along the Buckhannon & Northern Railroad.

This stratum has also been quarried to furnish stone culverts for the same railroad, one-half mile northeastward, along the west hillside of the river. Here, it is gray and brown in color, medium-grained and crops in a cliff 40 feet high.

In Union district, Marion, 15 feet of the upper portion of this ledge is quarried to a small extent at the east edge of the road on Hickman run, 1.2 miles southeast of the B. & O. R. R. station at Fairmont. The base of the quarry has an elevation of 1030′ A.T., aneroid, 200 feet below the horizon of the Pittsburgh coal.

The Morgantown sandstone is the "Murphy Sand" of the oil and gas well drillers, and has produced oil in Marshall and Wirt counties, West Virginia, and in Greene county, Pa., near the mouth of Dunkard creek.

The Elk Lick Coal.

The Elk Lick coal of the First Geological Survey of Pa. belonging from a few inches to 10 feet below the Morgantown sandstone, is fairly persistent, and, in the vicinity of Morgantown, Monongalia county, attains minable thickness. It crops 230 to 250 feet below the Pittsburgh coal and 50 to 75 feet above the fossiliferous Ames limestones. Its thickness and relative position in the rock column are exhibited in the sections for Beechwood, Easton, Morgantown, Sabraton, Mona and Round Bottom in Monongalia; and for Meadland in Taylor.

In **Monongalia county** an unsuccessful attempt was recently made to mine this bed on a commercial scale along th-

east hillside of the Monongahela river, opposite Mona (Granville). Here Reger collected a sample of the coal for analysis and obtained the following data:

Regal Coal Co. Mine, Elk Lick Coal.—No. 69 A, Map II.

		Ft.	In.
1.	Sandstone, massive, Morgantown	25	0
2.	Shale, gray	0	6
3.	Coal, hard, Elk Lick	2	6
4.	Shale, gray	2	0
5.	Limestone, hard, Elk Lick	1	0
6.	Shale, gray	2	0

(Elevation of coal, 903′ A. T., spirit level).

"Sample was taken in main heading, about 100 feet from the mine mouth from freshly cleaned face of coal. Coal is about 6 inches thicker at mouth of mine, but at the end of the main heading, about 200 feet in, the coal has been completely replaced by gray shale."

The composition of the sample is given under **No. 69A** (Laboratory No. 814H) in the table of coal analyses.

On the east side of the ravine in the north edge of Sabraton, there crops the greatest thickness of the Elk Lick coal observed in the area, as exhibited in the Sabraton section, page 118.

It is only 12 inches thick where it crops in the road at an elevation of 1210′ A.T., aneroid, 1.3 miles N 10° W of Dellslow.

Both in **Marion** and **Taylor** counties this coal is too thin, impure and irregular to be classed as a minable coal. However, an attempt to mine this vein was made in Booths Creek district, Taylor, 1.5 miles east of McGee, at an elevation of 1470′ A.T., aneroid, on the Albert M. Brown farm. Here, according to Isaac Brown, the bed at one place showed 4½ feet of clean coal, but thinned down to only 6 or 8 inches. The following section was obtained at an opening in the same vein on the land of Isaac Brown, 0.3 mile westward, at about the same elevation:

		Feet.
Black slate with coal streaks ....4′ 6″ Coal 0 6	Elk Lick coal	5
Sandstone, hard, coarse brown, massive, pebbly, forms great cliffs and boulders, Grafton		50

Slightly over a mile south of McGee this coal is only 4 inches thick where it crops in the ridge road at an elevation of 1435' A.T., aneroid, and only 3 inches thick, in the road, 0.7 mile northeast of Meadland. About the same thickness of coal occurs at this horizon at Boothsville, Knottsville and northward from Cecil.

The Elk Lick Limestone.

The Elk Lick limestone of Messrs. Pratt[7], belonging from 1 to 20 feet below the coal last described, is a widely persistent formation, ranging in thickness from 5 to 15 feet in layers separated by limy shale, and is dark gray in color and of fresh or brackish water origin.

In Union district, Monongalia, a sample of this limestone was collected for analysis and the following section measured at its crop on the east side of Cheat river, 1.4 miles northwest of Ices Ferry bridge over the latter stream:

			Feet.
1.	Sandstone, massive, Morgantown		15
2.	Concealed		25
3.	Limestone ....2'		
4.	Concealed 1		
5.	Coal 1	Elk Lick Limestone.....	8
6.	Shale, limy....2		
7.	Limestone gray and hard weathered yellow.2		

(Elevation of limestone, 955' B-A.T.)

The composition of the sample from No. 7 only of section is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	13.86
Ferric Iron (Fe_2O_3)	5.64
Alumina (Al_2O_3)	3.23
Calcium Carbonate ($CaCO_3$)	62.95
Magnesium Carbonate ($MgCO_3$)	10.90
Loss on ignition	2.86
Total	99.44

In the extreme northwestern corner of Taylor county, this ledge crops in the southwest edge of Boothsville, 5 feet thick,

7. Report HHH, Second Geol. Survey of Penna.

at an elevation of 960′ A.T., spirit level, 5 feet below the Elk Lick coal and 50 feet above the Upper Ames limestone. A sample for analysis was collected here, the composition of which is reported as follows by Messrs. Hite and Krak:

	Per cent.
Silica (SiO_2)	10.92
Ferric Iron (Fe_2O_3)	3.67
Alumina (Al_2O_3)	2.54
Calcium Carbonate ($CaCO_3$)	30.62
Magnesium Carbonate ($MgCO_3$)	41.73
Phosphoric Acid (P_2O_5)	0.22
Loss on ignition and undetermined	10.30
Total	100.00

The results class the ledge here as a dolomite, but too high in sandy and clayey matter for the manufacture of even coal or slow lime. It is best adapted to the manufacture of natural cement and road material.

In the northeast border of Courthouse district, Taylor, the Elk Lick limestone crops with a thickness of 5 feet along the ridge road between Berkeley run and Tygart Valley river, 1.8 miles southwest of Grafton, at an elevation of 1290′ A.T., aneroid.

This formation adds greatly to the fertility of Conemaugh soils and should furnish a fair quality of road metal at the localities mentioned above.

The West Milford Coal.

Immediately under the Elk Lick limestone there frequently occurs a thin—2 to 12 inches—slaty coal that has been designated the **West Milford**[8] **coal** from a town of that name in Harrison county.

The following section was measured at its crop in the extreme northwest point of Morgan district, Monongalia, along the B. & O. R. R. grade, directly opposite Maidsville Landing:

8. Ray V. Hennen, Doddridge-Harrison Rept., W. Va., Geol. Sur., p. 246; 1912.

	Ft.	In.
Sandstone, massive, Morgantown	35	0
Shale, gray	0	6
Coal 0′ 2″		
Shale, gray 1 0 } Elk Lick coal	1	4
Coal 0 2		
Limestone, gray and hard, Elk Lick, 18″ to	5	0
Shale, gray	2	0
Coal, slaty, West Milford	0	2
Fire clay shale	6	0
Shale, reddish	5	0
Concealed to river, Pool No. 9	30	0

(Elevation of West Milford coal, 836′ A. T., spirit level).

The one foot of coal included in the Cheat river section given above under the description of the Elk Lick limestone may possibly correlate with the West Milford bed. In this case the coal is between two ledges of limestone.

This coal was not observed in either Marion or Taylor, and at no point in the area does it appear to attain minable thickness.

The **Birmingham shale** of J. J. Stevenson[9] has been largely replaced in this area by the Grafton sandstone.

The Grafton Sandstone.

At 1 to 20 feet below the Elk Lick limestone and 15 to 20 feet above the Harlem coal in the vicinity of Grafton, Taylor county, there occurs a massive, coarse, pebbly and arenaceous stratum, ranging in thickness from 20 to 40 feet, that has been designated from this place the **Grafton sandstone**[10]. As mentioned above it has almost entirely replaced the Birmingham shale. Its thickness, character and relative position to other formations are exhibited in the sections for Beechwood, Easton, Sabraton, Little Falls and Round Bottom in Monongalia county; for Montana Mines in Marion; and for Grafton, Irondale, Thornton, Stonehouse, Cecil and Hepzibah in Taylor. Wherever it crops it generally makes a steep bluff and sometimes cliffs and large boulders 260 to 275 feet below the Pittsburgh coal. In Monongalia, Clinton district, the well-known "pictured rocks" along the east edge of the Kingwood

9. Report K, pp. 79 and 309-310, Sec. Geol. Survey of Penna.
10. I. C. White, Vol. II, W. Va. Geol. Survey, p. 255; 1903.

pike, 0.4 mile southeast of Ringgold, belong at this horizon. Here, on top of this sandstone, are found rude drawings of fish, deer, panthers and other animals, probably the work of Indians, concerning which Samuel T. Wiley[11] gives the following:

"The 'Pictured Rock,' about four or five miles from Morgantown, is now so covered and overgrown that deciphering its rude engraved figures, cut by the Indians, is a very difficult task. Years ago they were clearly discernible, and Howe, in his history of Virginia, says at page 382:

" 'On the plantation of Henry Hamilton there is a large flat rock, about 150 feet long and 50 wide, with numerous engravings of animals, well executed—such as panthers of full size, buffalo-tracks, horse-tracks, deer-tracks, turkey-tracks, eels, fish, women large as life, human-tracks, otters, beavers, snakes, crows, eagles, wild cats, foxes, wolves, raccoons, opossums, bears, elks, etc.' "

It is this ledge that is quarried in the same district along Kingwood pike, ¼ mile north of Ridgedale, where the following data was obtained by Reger:

	Ft.	In.
Sandstone, massive, quarry rock, capping knob, Grafton	10	0
Concealed	20	0
Shale, marine fossils, Ames	14	0
Coal, Harlem (1555' B-A. T.)	1	0
Shale, yellow	30	0

"Stone has lately been quarried for building purposes, and is coarse-grained, medium hard, micaceous, free from pebbles and a beautiful reddish brown in color, splitting readily and requiring little work to finish into perfect building blocks."

In Taylor this stratum attains a slightly better development than in either of the two other counties. It holds up the wide, flat ridges southward from McGee to Meadland. At Grafton it is the prominent cliff capping the hill in the north edge of the city (See Grafton section, page 152). The falls in Swamp run, 1.3 miles southeast of Knottsville, are in this sandstone. It is quarried on a small scale for building stone—mostly from large boulders of the parent ledge—by James McCue, Joseph McCue, Boggs Stark and Henry Jackson, along the road, 0.5 mile due north of Fetterman. Here the stone is coarse, brown and mottled with iron oxide, splitting readily

11. History of Monongalia County, W. Va., pp. 26-27; 1883.

into blocks of any desired form. The product is hauled to Grafton where it has a good reputation for durability and resistance to weathering.

The Ames Limestones.

At 275 to 300 feet below the Pittsburgh coal and 5 to 20 feet below the Grafton sandstone, there belongs a calcareous and very fossiliferous formation in northern West Virginia that was named by Andrews of the Ohio Geol. Survey the **Ames limestone.** It often occurs in two layers each 1 to 5 feet in thickness, separated by 10 to 20 feet of dark green shale with marine fossils in profusion; the top limestone being called the **Upper Ames**; the bottom, the **Lower Ames**; and the fossiliferous formation between, the **Ames shale**[12].

Both the limestones and shale carry a large number of marine fossils, and from a scientific standpoint, are considered the most interesting formations in the entire Appalachian field. I. C. White gives an excellent description of the distribution, character and fossil fauna of the same in this State on pages 256-261 of Vol. II of the State Survey reports. The limestones are more or less irregular and lenticular, but the shale is nearly always present and easily identified, owing to its dark green color and fossils. Their thickness and relative position in the rock column are exhibited in the sections for Beechwood, VanVoorhis, Morgantown, Sabraton, Aaron Run, Rock Forge, Little Falls, Anita, Mona and Round Bottom in Monongalia county; for Downs in Marion; and for Meadland, Webster, Grafton, Irondale, Thornton, Stonehouse, Cecil and Hepzibah in Taylor. These are very important key rocks in determining the approximate elevation of the Pittsburgh coal horizon after the latter passes into the air.

In Monongalia, at Morgantown, a fine exposure of both the limestones and shale along with the underlying Harlem coal occurs along the electric railroad grade at Point Breeze in Fourth Ward. Another good exposure is found in the east edge of the same town, in the deep cut about half-way up the

12. Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Sur., p. 250; 1912.

north hillside of Deckers creek. All are exposed along the hill road leading west from Dents run, slightly over a mile south of Mona (Granville).

In Marion, their crop is confined to Winfield, Union and Grant districts. In the extreme southern point of the latter area these limestones are in the bed of Husted creek, one-eighth mile east of Boothsville, where a sample was collected for analysis and the following section measured:

Boothsville Section, Showing Ames Limestone.

	Ft.	In.
Shale, sandy	5	0
Coal, slaty, Elk Lick	0	2
Shale, black, fossil plants, prolific	4	0
Limestone, dark gray, Elk Lick	5	0
Concealed	2	0
Sandstone, massive, coarse gray, Grafton	35	0
Concealed	3	0
Shale, sandy	5	0
Limestone, dark gray, marine fossils prolific. Ames, to creek bed	5	0

The composition of the sample from the Ames is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	6.55
Ferric Iron (Fe_2O_3) / Alumina (Al_2O_3)	3.32
Calcium Carbonate ($Ca CO_3$)	85.47
Magnesium Carbonate ($Mg CO_3$)	0.86
Phosphoric Acid (P_2O_5)	0.20
Loss on ignition	3.43
Total	99.83

The results reveal a fairly good limestone, although as a rule it seems higher in silica.

Southward in Taylor county one of the Ames limestones is found in the bed of Booths creek, 0.3 mile north of Santiago. The high knob on Hammond ridge, 0.9 mile northwest of Valley Falls, just barely catches the Ames shale in its summit, at an elevation of 1630′ A.T., aneroid. This is very near the crest of the Chestnut Ridge anticline. Southwest along the axis of the latter fold to near Meadland it crops close to the summits of the hills, and eastward, near the hill tops at Grafton and Cecil.

Fossil Fauna.—The Ames limestones and shale is one of the three rich marine fossil horizons of the Conemaugh series. During the latter part of 1911 collections were made in five different counties of West Virginia from these formations under the supervision of Dr. J. W. Beede of the University of Indiana, an expert on the Carboniferous invertebrate fauna of the western States. The specimens collected were studied and identified by Dr. Beede, whose report on those from Harrison county is given on pages 254-255 of the Doddridge-Harrison report of the State Survey, and those from Monongalia, Marion, Taylor and Preston counties as follows:

Monongalia County*. Point Breeze Cut. Morgantown.
Upper Ames Limestone:

Ambocoelia planoconvexa.
Chonetes granulifer, a.
Composita argentia, a.
Crinoid fragments.
Deltopecten occidentalis?
Derbya crassa.
Myalina? sp.
Productus cora.
Productus nebraskensis, a.

Ames Shale:

Ambocoelia planoconvexa.
Euphemus carbonarius.
Nucula parva, a.
Plant.
Patellostium montfortianum.
Pleurotomaria sp.
Strophalosia? sp.

Ames Shale Immediately Over Lower Ames Limestone:

Ambocoelia planoconvexa, a.
Bellerophon sp.
Chonetes granulifer.
Euomphalus catilloides.
Euphemus carbonarius.
Gastropod sp.
Leda attenuata.
Leda bellistriata.
Nucula parva, c.
Patellostium montfortianum.
Pelecypod sp.
Pleurotomaria sp.
Tainoceras occidentalis?

*In these lists, "a" means the specimens of species are abundant; "c." common; and "r," rare.

Lower Ames Limestone:

Ambocoelia planoconvexa, c.
Aviculopecten? sp., r.
Chonetes granulifer, a.
Nucula parva, a.
Pelecypod sp.
Pleurophorus sp.
Strophalosia sp.

Hill Road, Two Miles Due West of Morgantown.

Lower Ames Limestone:

Chonetes granulifer.
Strophalosia sp.

Rogers Cut, East Morgantown:

Upper Ames Limestone:

Ambocoelia planoconvexa.
Chonetes granulifer, c.
Composita argentia, a.
Crinoid fragments.
Deltopecten occidentalis?
Myalina subquadrata, c.
Pelecypod.
Productus cora.
Productus nebraskensis, a.

Upper Ames Limestone and Shale (wash):

Ambocoelia planoconvexa
Bryozoan sp.
Chonetes granulifer.
Composita argeinta, a.
Crinoid fragments.
Deltopecten occidentalis.
Myalina subquadrata.
Productus cora.
Productus nebraskensis, c.
Rhipidomella pecosi, c.
Spirifer Cameratus.
Strophalosia sp.

Lower Ames Limestone:

Chonetes granulifer, a.
Nucula parva, c.
Patellostiun montfortianum, r.

Marion County. Boothsville, East Edge of.

Upper Ames Limestone:

Masses of Chonetes granulifer.
Productus cora.

Taylor County. Pruntytown, 1.5 miles NW of, Brush Hill Road.

Ames Shale:

Ambocoelia planoconvexa.
Aviculopecten? sp.
Aviculopinna americana?
Bellerophon sp.
Bellerophon percarinatus.
Bulimorpha sp.
Edmondia? sp.
Euphemus carbonarius.
Leda attenuata, c.
Nucula sp.
Nucula ventricosa.
Nucula parva.
Ostracoda.
Patellostium montfortianum.
Pelecypod sp.
Productus cora.
Productus nebraskensis.
Strophalosia sp.
Yoldia sp.

Preston County, 1 Mile NE of Kingwood, M. & K. R. R. Cut.

Ames Shale:

Aclisina? sp
Aclisina swallowana.
Ambocoelia planoconvexa, a.
Astartella gurleyi, c.
Astartella vera, r.
Aviculopecten sp., r.
Bulimorpha chrysalis.
Bellerophon percarinatus.
Bellerophon stevensanus? r.
Bulimorpha sp.
Bulimorpha? sp.
Chonetes granulifer, c.
Chonetes variolatus.
Crinoid fragments.
Derbya crassa, c.
Edmondia aspenwallensis?
Endothyra? sp., r.
Euomphalus catilloides.
Euphemus carbonarius, c.
Leda attenuata, c.
Loxonema rugosum, r.
Loxonema semicostatum, r.
Loxonema scitulum, r.
Nucula parva, a.
Orthoceras rushensis.
Orthonema quadricarinatum.
Orthonema? sp.
Orthonema Cf. subtaeniatum, r.
Patellostium montfortianum.
Pelecypod. Cf. Allorisma geinitzi.

Pelecypod. Two species.
Pleurophorus Cf. obsoletus.
Pleutomaria Cf. brazoensis.
Productus cora? r.
Serpula? sp., r.
Sphaerodoma primigenia?
Soleniscus brevis.
Soleniscus paludinaeformis?
Tainoceras occidentalis? r.
Worthenia Cf. speciosa a,

While Professor of Geology at the State University, Dr. J. J. Stevenson made a large collection of specimens from the Ames in the vicinity of Morgantown, and submitted the same to the late F. B. Meek for study and classification. Mr. Meek's letter to Dr. Stevenson, dated Nov. 8, 1870, and its accompanying list of fossils, as published on pages 257-259 of Vol. II of the State Survey reports, are as follows:

"The specimens sent from the lower Coal Measures are nearly all forms common in the coal series of Indiana, Illinois, Missouri, Kansas, Nebraska, etc., though few of them have before been found so far eastward. In some of the states mentioned, nearly all of these species range through the whole of the Coal Measures. Some of them, however, are locally more restricted. This great range of the species of invertebrate remains in the Coal Measures of the western states has long since satisfied me that these fossils cannot generally be relied upon as a means of identifying particular beds or horizons in our Coal Measures throughout wide areas; though particular grouping of species may sometimes serve as guides in this respect, within limited areas. The Coal Measure forms, however, enable us at once to distinguish beds of that age from any of the lower Carboniferous or older rocks.

"The great length of time through which most of these fossils must have continued to live, will be better understood when it is stated that nearly all of the species enumerated in this list from the lower Coal Measures of West Virginia, also occur even in the upper Coal Measure beds in Nebraska, referred by Profs. Marcou and Geinitz to the Permian or so-called Dyas. Indeed, the collections from these two widely separated localities and horizons, contain so many of the same species, that if shown to almost any geologist unacquainted with the range of species in our Coal Measures, he would scarcely hesitate to adopt the conclusion that they came from exactly the same horizon in the series. Yet from what is known of the geology of your region, and that of the states farther west, it is probable that the beds from which your collections were obtained, hold a position from 1,000 to 1,500 feet or more below those alluded to in Nebraska.

"From such facts as this, it would seem that although there were many elevations and depressions, as well as other consequent changes, the climatic and other physical conditions affecting animal life, must have remained remarkably uniform throughout the whole of the long continued coal period. Very truly yours,

F. B. MEEK."

List of Fossils identified by F. B. Meek from horizon of the Crinoidal or Ames Limestone, near Morgantown, West Virginia:

*Crinoidal fragments—Some pentagonal, star-shaped discs of columns.

Crinoidal columns.

Hemiphronites crassus **Meek** and **Hayden.**

Chonetes smithi **Norwood** and **Pratten.**

Chonetes. Seem to differ from **C. granulifera,** Owen, only in being smalier.

*Productus nebrascensis **Owen.**

*Productus prattenanus **Norwood.**

*Productus semireticulatus **Martin** sp. Seems to be rare in our beds.

*Discina nitida (?)

*Pseudomonotis. (Monotis of some authors but not of Brown). A fragment, but showing exactly the irregular regulating costae and striae, with vaulted scales seen on the ribs in that genus.

*Aviculopecten carbonarius **Stevenson** sp.—Pecten broadheadi **Swallow,** and Pecten hawni **Geinitz.**

*Myalina subquadrata **Shumard,** var, **ampla.**

Myalina. Undetermined species. Very small. Probably a young shell.

Allorisma. Undetermined species.

*Nucula ventricosa **Hall.**

*Nucula parva **McChesney.**

†Nucula anodontoidea **Meek.**

*Nuculana bellistriata **Stevenson** sp. A very small attenuated variety. Common in the so-called upper Dyas, Nebraska City, Nebraska.

Astartella. Undetermined species.

†Macrodon obsoletus **Meek.**

Macrocheilus primigenius **Conrad.**

*Macrocheilus ventricosus **Hall.**

Macrocheilus. Undetermined species.

*Bellerophon montfortianus **Norwood** and **Pratten.**

Bellerophon percarinatus **Conrad.**

*Bellerophon carbonarius **Cox.**

Bellerophon meekianus **Swallow.**

*Pleurotomaria grayvilliensis **Norwood** and **Pratten.**

Pleurotomaria. Undetermined species. A very small depressed species.

*Orothoceras cribrosum **Geinitz.**

*Nautilus occidentalis **Swallow.**

Nautilus. Undetermined species.

Productus. Undetermined species. Very small, concentrically wrinkled.

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*Species known to range through the whole of the Coal Measures in the West, even into the upper beds at Nebraska City, Neb., referred by Profs. Marcou and Geinitz to the Permian or so-called Dyas.

†New species.

*Athyris substilita Hall. Very abundant and presenting all the usual varieties.
*Spirifer (Martinia) planoconvexus Shumard.
*Spirifer cameratus Morton.
Aviculopecten. Undetermined species. Probably A. occidentalis Shumard.

At the end of this chapter is given a tabular list, prepared by Dr. Beede, of species common to the Ames, Pine Creek and Brush Creek limestones.

The Harlem Coal.

At a few inches to 10 feet below the Ames limestones there occurs a thin—12 to 18 inches—very persistent coal in the northwestern portion of the State. It was first named the **Harlem coal**[13] by J. S. Newberry from a town of that name in Carroll county, Ohio, where it was mined in shafts. The names "Crinoidal" and "Friendsville" have been applied to the same bed by the Pennsylvania and Maryland Surveys, respectively. Its crop is confined to the eastern edge of Cass and Grant districts, and the northwest portions of Union, Morgan and Clinton in Monongalia; over most of the area of Winfield, Union and Grant districts, Marion; and in all the districts of Taylor. The approximate position of the bed can be readily ascertained therein by subtracting 330 feet from the elevation of the Pittsburgh coal as shown on Map II. Its thickness and relative position to other formations are exhibited in the sections for Beechwood, Easton, Morgantown, Aaron Run, Rock Forge, Little Falls, Anita and Round Bottom in Monongalia; and for Webster, Grafton, Irondale, Thornton and Hepzibah in Taylor.

In **Monongalia county** the following detailed section was measured at the crop of the Harlem coal along the east edge of Morgantown, in the deep cut on the north side of Deckers creek:

	Feet.
Limestone, in layers, marine fossils, Upper Ames	4
Shale, dark, bluish green, Ames	10
Concealed	9
Limestone, marine fossils, Lower Ames	2
Shale	1
Coal, Harlem	1
(Elevation of coal, 930' A. T., aneroid).	

13. Bull. Geological Society of America, Vol. 17, p. 156; 1906.

Along the electric railroad grade in the northwest edge of the same town this bed has a thickness of 18 inches. There both the Ames limestones and shale are finely exposed.

Two miles southwestward the following section was measured at its crop in the hill road leading west from Dents run, 1 mile due south of Mona (Granville):

	Ft.	In.
Limestone, marine fossils, Lower Ames	1	6
Shale	4	0
Coal, slaty 0′ 6″		
Shale, gray 0 5 } **Harlem coal**	1	7
Coal 0 8		
Fire clay shale		

(Elevation of coal, 910′ A. T., aneroid).

In **Marion** this coal attains about the same development as in Monongalia county, as revealed by the following section measured by Reger at its crop in the extreme southern edge of Winfield district at the north end of the private road, 1.7 miles due west of Neel:

	Ft.	In.
Concealed from top of knob	35	0
Shale, green. marine fossils, Ames	5	0
Coal, Harlem	1	6
Shale, variegated and red, Pittsburgh	60	0

(Elevation of coal, 1685′ A. T., aneroid).

One-half mile S 30° W of Neel, on the crest of the Chestnut Ridge anticline, according to Reger, the same thickness of coal is exposed at this horizon, at an elevation of 1795′ A.T., aneroid. Here it is overlaid by the same green fossiliferous shale. Two miles and a half northward, on the south side of the high knob located 0.2 mile south of Nebo church, this bed is only 12 inches thick, according to Reger, at an elevation of 1735′ A.T., spirit level, coming immediately under a fossiliferous shale.

In **Taylor** the Harlem coal is slightly thicker in some localities than in the other two counties. It is this bed that was once mined on the Jas. B. Scrannage farm and likewise on the O. W. Scrannage farm at an elevation of 1444′ A.T., spirit level, 0.2 mile northwest and 0.2 mile northeast of McGee, respectively. It is reported 24 inches thick at each

of these mines, but it perhaps carries a shale parting as shown by the following section measured at its crop, 1.6 miles north of McGee, at the milk-house of Nathan Curry, at an elevation of 1430′ A.T., aneroid:

		Ft.	In.
Shale, black, marine fosslis, Ames		3	0
Coal ..... 0′ 5½″			
Shale, black 0 11	Harlem coal	1	10½
Coal 0 6			
Fire clay shale			

This coal dips rapidly southward along the nose of the Chestnut Ridge anticline to an elevation of 1265′ A.T., spirit level, at its crop on the east bank of Plummer run, just south of the road fork, 1 mile eastward from Meadland:

	Ft.	In.
Shale	10	0
Limestone silicious, marine fossils, Upper Ames	2	6
Shale, dark, marine fossils, Ames	6	0
Coal, Harlem	1	0
Fire clay shale to Plummer run	13	0

In the central portion of Courthouse district, Reger measured the following section at the crop of this coal in a B. & O. railroad cut, ¾ mile east of Bryden:

		Ft.	In.
Sandstone, shaly, Grafton		5	0
Limestone, marine fossils, Upper Ames		2	0
Shale, brown ..... 10′	Ames	20	0
Shale, dark 10			
Coal, good, Harlem		1	4
Shale, yellow, to railroad grade		8	0

(Elevation of coal, 1070′ A. T., aneroid).

In the northwest portion of Fetterman district this coal crops in the private road, 0.6 mile due east of "Dean Schoolhouse", at an elevation of 1620′ A.T., aneroid, where the following section was measured, giving the thickest coal at this horizon observed in the area:

		Ft.	In.
Sandstone, Grafton			
Shale, marine fossils, Ames		25	0
Coal, slaty ..... 0′ 8″			
Fire clay shale 2 0	Harlem coal	4	8
Coal 2 0			
Fire clay shale		8	0
Limestone, nodular, brecciated, Ewing		2	0

The crop of this coal is well exposed along the road in the western border of Knottsville district, slightly over a mile due west of Eby, at an elevation of 1660′ A.T., aneroid, where the following section was measured:

		Ft.	In.
1.	Sandstone, massive, Grafton	35	0
2.	Shale, dark green, marine fossils, Ames	17	0
3.	Coal, Harlem	1	2
4.	Fire clay shale	10	0

In this area the Harlem coal is too thin and irregular ever to be mined successfully, especially in competition with thicker and better coals in the same locality. No samples were collected for analysis, but a fair idea of its composition and fuel value in this portion of the State is given on pages 256-262 of the Doddridge-Harrison Report of the State Survey.

The Ewing Limestone.

The **Ewing limestone** of the Ohio Geological Survey, belonging 1 to 10 feet below the Harlem coal, is a dark gray stratum, weathering yellowish gray, and a fresh or brackish water deposit. Its thickness and relative position to other formations are exhibited in the sections for Rock Forge in Monongalia, and for Webster and Stonehouse in Taylor. It is generally more or less nodular, brecciated and irregular. Reger reports this ledge 5 feet thick in the bed of Robertson run, ¾ mile north of Colfax, Marion county, at an elevation of 995′ A.T., aneroid, and 4 feet thick along the hill road on the head of Reuben run, 1.6 miles east of Canton (Winfield).

In Taylor it appears in better development than in either of the other two counties. It is 3 feet thick and fairly pure at its crop along the road on Corbin branch along the western edge of Booths Creek district, 1 mile south of Santiago. It rises rapidly southward from the latter point and at the road fork, 2 miles N 85° W of Meadland, crops at an elevation of 1200′ A.T., aneroid, where the following section was measured:

	Feet.
Limestone, marine fossils, Lower Ames	1
Concealed	10
Coal, Harlem	1
Fire clay shale	4
Limestone, nodular, brecciated, Ewing	4

In the southern border of Fetterman district the following section was measured at the crop of this limestone at the north edge of the Northwestern pike, 0.5 mile eastward from Blueville:

	Ft.	In.
Shale, dark, marine fossils, Ames		
Coal, Harlem	0	6
Fire clay shale and red shale	10	0
Limestone, brecciated and nodular, Ewing	2	0
Reds, Pittsburgh		
(Elevation of limestone, 1320' A. T., aneroid).		

No sample of this limestone was collected for analysis, but a fair idea of its composition in this portion of the State is given on page 263 of the Doddridge-Harrison Report. Therein it is shown to be adapted to the manufacture of hydrated lime for agricultural purposes.

The Pittsburgh Red Shale.

The **Pittsburgh Red Shale** of White[14], belonging immediately under the Ewing limestone, is a soft, red or purple shale, often marly and containing nuggets of impure limestone and iron ore, the whole ranging in thickness from 30 to 100 feet. This band of reds is nearly always recorded by oil and gas well drillers in the area, and, on account of its bad caving tendency when penetrated by the drill, it is known as the "Big Red Cave"; hence, much care has to be exercised in drilling through the same to prevent losing the drilling tools. On pages 263-265 of Vol. II of the State Survey reports, I. C. White gives an interesting account of these shales. Their thickness and relative position in the rock column are exhibited in the sections for Easton, Morgantown and Round Bottom in Monongalia; for Downs in Marion; and for Meadland, Grafton, Thornton, and Cecil in Taylor.

14. I. C. White, Bull. No. 65, U. S. G. Survey, p. 92; 1891.

In Monongalia, the shale pit of the Morgantown Brick Company, in the northwest edge of Fourth Ward, Morgantown, is in this horizon, the composition and physical properties of which are given on pages 235-236 of Vol. III of the State Survey reports.

The Saltsburg Sandstone.

The **Saltsburg sandstone** of J. J. Stevenson, belonging 40 to 60 feet below the Harlem coal and just above the Bakerstown coal, ranges from 15 to 30 feet in thickness and is very irregular both in character and distribution, sometimes being grayish white, massive and pebbly, and again greenish gray, flaggy and micaceous. It correlates with the Moundsville oil sand of the drillers. Its thickness, character and relative position in the rock column are exhibited in the sections for Easton, Morgantown, Sabraton, Aaron Run, Rock Forge and Triune in Monongalia; for Glover Gap, Downs and Montana Mines in Marion; and for Grafton, Irondale and Cecil in Taylor. On the State University campus at Morgantown, it is this ledge that forms the falls in Falling run, where it has lost its massive character. Southwestward along the Buckhannon & Northern Railroad grade, it has thickened up to 20 feet, ¼ mile northeast of Round Bottom, being here dark gray, massive and medium grained, and coming 3 feet above the Pine Creek limestone.

No quarries were observed on this ledge.

The Bakerstown Coal.

At 1 to 10 feet below the Saltsburg sandstone and 75 to 100 feet below the Ames limestone there belongs a coal that frequently attains minable thickness in West Virginia. This vein is known as the **Bakerstown**[15] **coal,** but is referred to in Maryland as the **Barton** vein. Although quite persistent in this area, it is very irregular in thickness as is revealed in the sections for Morgan Run, McClaren and Triune in Monongalia; and for Thornton, Thornton S W and Cecil in Taylor.

15. I. C. White, Report Q, Second Geological Survey, Penna.

In **Monongalia county** its crop is confined to the central portion of Union district and the western portions of Morgan and Clinton. In Union it is this bed that crops in the road near the residence of Mack Bayles, 0.4 mile southward from the Ices Ferry bridge over Cheat river, at an elevation of 993′ A.T., spirit level. Here it is 3 feet thick and quite pure. This coal was also once mined on the east side of Cheat, near Ices Ferry bridge, by stripping and the coal used at the old Green Spring iron furnace operated there over 50 years ago, where it was reported 3 to 4 feet thick and of fair quality. Westward it appears to thin away, since it is only 16 inches thick in the McClaren boring (320), 1 mile southeast of VanVoorhis, and at Morgantown, has thinned away entirely where its horizon is exposed on the west side of the river. It also appears to be absent along the B. & N. R. R. grade, one-fourth mile northeast of Round Bottom; in fact, this same condition seems to hold true all along the river between Morgantown and Grafton.

In **Marion** the crop of this bed is confined to an area 3 to 4 miles wide, extending southwest across the central portions of Winfield, Union and Grant districts, but at no point was coal of minable thickness observed in the county. The following section was measured at its crop in the hill road in the eastern border of Grant, 0.6 mile westward from Hall Mill:

	Feet.
Sandstone, massive, Saltsburg	20
Shale, sandy, buff	5
Concealed	10
Slate, black ,and concealed	4
Coal, Bakerstown	1
Concealed	25
Limestone, gray and hard, Pine Creek, to run	3

(Elevation of coal, 1015′ A. T., aneroid).

In **Taylor** the crop of the Bakerstown coal is confined to the northeast portion of Booths Creek district, over most of Fetterman and Knottsville, and the eastern border of Courthouse. The approximate position of its crop can readily be ascertained in this county as well as in Monongalia and Marion by subtracting 420 feet from the elevation of the

Pittsburgh coal as shown on Map II. It crops in the road 1 mile north of Fetterman at an elevation of 1160′ A.T., aneroid, where it is only 6 inches thick. One-half mile west of Fetterman this coal was once opened on the south side of the pike at an elevation of 1110′ A.T., aneroid. The mine had fallen shut so that it was not possible to get a section of the bed, but all signs demonstrated that it had not been satisfactory.

In the western edge of Booths Creek district this coal crops at the road fork on Corbin branch, 2.3 miles N 80° W of Meadland, at an elevation of 1074′ A.T., spirit level, where it is only 13 inches thick.

In the southern edge of Knottsville district this coal has thickened up to minable dimensions 0.2 mile northwest of Cecil, where it has been mined for domestic fuel, having a thickness of 3 feet (see Cecil section, page 159).

Three-fourths mile northeast of Cecil a sample for analysis was collected and the following section was measured at a mine in this vein:

J. J. Shroyer Mine, Bakerstown Coal—No. 71 on Map II.

		Ft.	In.
1.	Sandstone, visible, Saltsburg	7	0
2.	Shale, sandy	6	0
3.	Shale, dark	2	0
4.	Coal, bony....0′ 3″		
5.	Coal, good, soft....2 5 — Bakerstown	2	8
6.	Fire clay shale		
	(Elevation of coal, 1375′ A. T., aneroid).		

The composition, calorific value and fuel ratio of the sample from No. 5 only of section are given under **No. 71** (Laboratory No. 574H) in the table of coal analyses.

One mile and a half N 75° E of Knottsville an attempt was made to mine this bed near the road fork, on the east hillside of Glade run, at an elevation of 1516′ A.T., spirit level. The mine had fallen shut; hence, a section could not be obtained.

Along the Eastern border of Knottsville district the following section was measured at the crop of this coal in the road, 0.6 mile southwest of Eby:

	Ft.	In.
Shale, red and sandy	15	0
Coal, Bakerstown	1	1
Fire clay shale	5	0

(Elevation of coal, 1615′ B-A. T.)

In the northern edge of the same district, Reger collected a sample for analysis and measured the following section at a mine in this bed on the west hillside of Rocky branch, 1.3 miles N 10° E of Knottsville:

John Williams Mine, Bakerstown Coal—No. 70 on Map II.

			Ft.	In.
1.	Slate			
2.	**Coal, good** 1′ 7″			
3.	Slate 0 0½	**Bakerstown**	2	5½
4.	**Coal, good** 0 10			
5.	Shale, gray		3	0
6.	Concealed		20	0
7.	Shale, green, brecciated, limy		10	0

(Elevation of coal, 1260′ B-A. T.)

The composition, calorific value and fuel ratio of the sample from Nos. 2, 3 and 4 are given under **No. 70** (Laboratory No. 581H) in the table of coal analyses.

The results of the two analyses show this bed to be an exceptionally good coal for fuel purposes.

This coal is only 6 inches thick at its crop in the road, 2.3 miles northwest of Irontown and 0.2 mile northeast of the U. S. G. Survey bench mark—1506′ A.T.—where, according to Reger, it comes 100 feet below the Harlem coal, at an elevation of 1585′ A.T., aneroid.

Sufficient data have been given to show that the Bakerstown coal in each of the three counties is very patchy and irregular in its nature and for that reason can hardly be classed as a minable coal at present. However, Union district, Monongalia, and Knottsville district, Taylor, should sometime furnish a fairly large tonnage of this coal when the better and thicker veins approach exhaustion.

The Pine Creek Limestone.

The **Pine Creek limestone** of I. C. White[16], belonging 90

16. Report Q, Sec. Geol. Surv. Penna.

PLATE XX.—"Raven Rocks" at Uffington, Monongalia County. Here the Buffalo and Mahoning sandstones have coalesced into a massive cliff 65 ftet thick

to 120 feet below the Ames limestone and 5 to 30 feet below the Bakerstown coal, is a dark gray stratum, often carrying many marine fossils and for that reason it is frequently mistaken for the Ames. It crops over practically the same area as that outlined above for the Bakerstown coal. Its thickness and relative position in the rock column are exhibited in the sections for Morgantown and Aaron Run in Monongalia, and for Powell in Marion.

In **Monongalia** its crop is well exposed along the B. & N. R. R. grade at Morgantown, a short distance below Lock No. 10 (see Morgantown section, page 115). Here it does not appear to carry any marine fossils. Three miles southward, however, it has marine fossils in profusion at its crop near the "Raven Rocks" on the east side of Booths creek, 0.3 mile southeast of Uffington, where the following section was measured with hand-level:

Uffington Section.

	Thickness. Feet.	Total. Feet.
Limestone, marine fossils Ames	5	5
Concealed and reds	94	99
Sandstone, flaggy, Saltsburg	15	114
Shale, red and sandy	20	134
Limestone, silicious, many marine fossils, Pine Creek	2	136
Shale, green and red	10	146
Sandstone, massive, grayish white, Buffalo	55	201
Coal, Brush Creek, 6" to	0	201
Sandstone, massive, Upper Mahoning	25	226
Shale, black, (Mahoning coal horizon)	0.5	226.5
Concealed	5.5	232
Shale, gray with marine and plant fossils.....20' / Shale, dark, with plant fossils .....14 — Uffington shale	34	266

The bottom of the section comes near the base of the Conemaugh series as the Upper Freeport coal is reported to have been mined by stripping from the bed of Booths creek just above at the F. M. Johnson No: 1 well (341), the record of which is published on page 133 of Vol. I(A) of the State Survey reports. The well starts about 10 feet above the latter coal.

In Grant district the following section was measured at the crop of this limestone along the B. & N. R. R. grade, ¼ mile northeast of Round Bottom:

		Ft.	In.
Sandstone, limy, dark green, massive, Saltsburg.		20	0
Shale, brown			
Shale, gray			
Limestone, dark gray and hard....0′ 10″			
Shale, limy 1 8	Pine Creek		
Limestone, dark gray.1 6	Limestone ..... (845′ L.A. T.)	10	6
Shale, yellow, gray and limy 5 6			
Limestone, dark gray marine fossils....1 0			
Fire clay shale		5	0
Concealed to river, Pool No. 11		25	0

This is the greatest total section of this limestone observed.

In Marion a sample of this ledge was collected for analysis and the following section measured at its crop in the bed of a small stream in the southeast corner of Grant district, 0.6 mile westward from Hall Mill:

		Feet.
1. Coal, Bakerstown		1
2. Concealed		20
3. Limestone, yellowish and hard....3′	Pine Creek	4
4. Limestone, blue and hard 1		

(Elevation of limestone, 985′ A. T., aneroid).

The composition of the sample from Nos. 3 and 4 of section is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	11.72
Ferric Iron (Fe_2O_3) / Alumina (Al_2O_3)	9.43
Calcium Carbonate ($CaCO_3$)	59.49
Magnesium Carbonate ($MgCO_3$)	15.33
Phosphoric Acid (P_2O_5)	0.27
Loss on ignition	2.92
Total	99.16

Two miles and a half eastward it crops on the north hillside of Tygart Valley river, 0.5 mile northeast of Powell, at an elevation of 1320′ A.T., aneroid, having there a thickness of 2 feet and carrying many marine fossils (See Powell section, page 145).

In **Taylor** this limestone is 15 inches thick at its crop along the road in the southwest border of Booths Creek district, on the west hillside of Lost run, 1.4 miles southeast of McGee. Here it carries many marine fossils and has an elevation of 1152′ A.T., spirit level, 87 feet above the fossiliferous Brush Creek limestone in the bed of Lost run, 0.2 mile southeastward.

This ledge is too thin, silicious and irregular ever to have much economic value, either for road metal or agricultural lime.

Fossil Fauna.—A collection of fossils was made from the Pine Creek limestone from the Uffington, Colfax and McGee regions of Monongalia, Marion and Taylor counties, respectively, and forwarded to Dr. J. W. Beede as with the Ames collection for study and classification, who reports as follows thereon:

Pine Creek Limestone Fossils:

Monongalia County, 0.3 mile SE of Uffington Pine Creek Limestone:

Crinoid fragments.
Composita argentia.
Fish tooth.
Orthoceras? sp.
Productus cora.
Productus nebranskensis, a*
Productus Cf. semireticulatus.
Rhombopora lepidodendroidea.

Marion County, Robertson run,, 1 mile north of Colfax:

Ambocoelia planoconvexa.
Fistulipora? sp.
Chonetes granulifer.
Chonetes variolatus. Masses of these two species of Chonetes.
Coprolite of comminuted shells.
Derbya crassa?
Productus cora.

*The letter "a" means specimens of species are abundant.

Taylor County, 1.8 miles NW of Pruntytown, Edge of Hill Road:

Aviculopecten? sp.
Bellerophon? sp.
Crinoid fragments.
Derbya crassa.
Euomphalus catilloides.
Lophophyllum profundum.
Ostracoda.
Productus cora.

At the end of this chapter is given a tabular list of fossils prepared by Dr. Beede showing species common to the Pine Creek, Ames, and Brush Creek limestones.

The Buffalo Sandstone.

The **Buffalo sandstone** of White[17], belonging 10 to 30 feet below the Bakerstown coal and 1 to 5 feet under the Pine Creek limestone, is a massive, grayish white and pebbly rock, ranging in thickness from 40 to 100 feet. It correlates with the First Cow Run oil sand of Cow Run, Ohio, and the Little Dunkard sand of eastern Greene county, Pa. In the area under discussion it is a prominent cliff former and generally strews the ground with large boulders wherever it crops, or makes a very pronounced steep slope around the hillsides, 60 to 90 feet above the base of the Conemaugh series. The thickness, character and relative position of this stratum in the rock column are exhibited in the sections for St. Cloud, Cassville, Morgan Run, Mont Chateau, Easton, Morgantown, Sabraton, Aaron Run, Rock Forge, Little Falls and Triune in Monongalia; for Downs and Powell in Marion; and for Grafton, Irondale, Thornton, and Stonehouse in Taylor county.

In **Monongalia** this sandstone forms the cliffs at Morgantown extending along Deckers creek from near the mouth up to the dam at the power station of the W. Va. Traction & Electric Co., the M. & K. R. R. grade at this dam running on top of the sandstone. Farther up the same stream it is the great cliff rock along the north side of the creek, northwest of Dellslow station. It is this stratum that has been quarried

17. I. C. White Report Q, Second Geol. Survey, Penna.

PLATE XXI.—Buffalo Sandstone, Keck quarry, at Morgantown.

along the B. & N. R. R. grade on the opposite side of the river from Morgantown, and stone from this quarry was used in the construction of the new M. E. Church and President's house at the State University in the latter town. It has also been quarried on the east side of Booths creek, 0.3 mile southeast of Uffington. A short distance above the latter quarry the well-known "Raven Rocks" are formed in this ledge which in places has cut away the underlying Brush Creek limestone, shale and coal, and coalesced with the Mahoning sandstone below (See Uffington section). It does likewise along the B. & O. R. R. grade between Scrafford and Uffington, and also along the B. & N. R. R. opposite, across the Monongahela river.

Opposite Little Falls the Buffalo sandstone has been quarried to furnish stone for the construction of Locks Nos. 12 and 13 where the quarry face is about 200 feet long and 50 to 60 feet high. One mile northwestward it forms the great cliff, 60 to 70 feet high, immediately north of Lock No. 13. Three-fourths mile above the latter lock, Reger reports this sandstone 99 feet thick, hand-leveled measurement, at an elevation of 869′ L-A.T., coming 3 inches above 16 inches of Brush Creek coal.

On the southwest edge of Clinton district the great cliff rock along Whiteday creek at Whiteday (Smithtown) is formed by this sandstone.

In **Taylor** the Buffalo attains a fine development in the vicinity of Grafton where it makes great cliffs along the river and Threefork creek, 50 to 100 feet above B. & O. R. R. grade. It is quarried for building purposes on the opposite side of the river from Fetterman, and also on the north hillside of Threefork creek in the east edge of Grafton. These quarries will be discussed more fully on subsequent pages under "Building Stone".

The Brush Creek Limestone and Shale.

From a few inches to 5 feet below the base of the Buffalo sandstone there occurs a calcareous and very fossiliferous stratum, ranging in thickness from a few inches to 3 feet, that

has been designated the **Brush Creek limestone** by I. C. White[18] from a stream of that name in Butler county, Pa. Between this limestone and the Brush Creek coal below, there generally comes 3 to 10 feet of dark or black shale which frequently contains marine fossils in its upper half, while in the basal portion of the same, many fossil plants occur. This shale has also been designated the **Brush Creek** on account of its close association with the coal and limestone of that name. The thickness and relative positions of this limestone and shale in the rock column are exhibited in the sections for Easton, McClaren, Sabraton and Aaron Run in Monongalia; for Powell in Marion; and for Webster, Grafton and Irondale in Taylor county.

The shale crops along the road in the southwest corner of Morgan district, Monongalia, at Scrafford, at an elevation of 860′ B-A.T., where the following section was measured by Reger:

	Ft.	In.
Sanstone massive, Buffalo.....		
Slate, dark, with marine fossils.....	10	0
Coal, Brush Creek.....	0	6

On the southwest border of Grant district, both the limestone and shale crop along the B. & N. R. R. grade, 1 mile northwest of Little Falls, immediately north of Lock No. 13, Monongahela river, where the following section is exposed:

	Thickness. Feet.	Total. Feet
Sandstone, massive, great cliffs, Buffalo....	60	60
Shale, dark, with iron ore nodules.....	7	67
Limestone, shaly, marine fossils, Brush Creek	0.5	67.5
Shale, dark, fossiliferous, Brush Creek.....	7	74.5
Coal, Brush Creek, 9″ to (898′ L-A. T.).....	1	75.5
Fire clay shale, gray.....	20	95.5
Iron carbonate ore, Johnstown.....	0.5	96
Fire clay shale, gray.....	6	102
Sandstone, limy.....	4	106
Sandy shale	2	108
Fire clay shale, red at top.....	11	119
Concealed to river, Pool No. 13.....	12	131

A short distance northwest the Buffalo sandstone has

18. Report Q, Second Geol. Survey, Penna.

almost entirely cut away the intervening limestone and shale down to the Brush Creek coal. A sample for analysis was collected from the 6 inches of iron carbonate or Johnstown ore at 95.5′ from the top, the composition of which is given under "Iron Ore" in Chapter XIII.

The following section is exposed at the crop of the Brush Creek shale at the road fork on the west bank of Whiteday creek, opposite Whiteday (Smithtown):

	Feet.
Sandstone massive, Buffalo	60
Shale, black, marine, fossils, Brush Creek	10
Coal, Brush Creek (965′ B-A. T.)	1
Fire clay shale and concealed to creek	15

In **Marion** the limestone crops on the southwest edge of Union district along the B. & O. R. R. grade, 1.5 miles southwest of Colfax, at an elevation of 897′ A.T., spirit level, where the following section was measured:

	Ft.	In.
Sandstone, shaly and flaggy	25	0
Shale, dark, with iron ore nodules	20	0
Limestone, shaly, many marine fossils, Brush Creek	3	0
Coal, Brush Creek	1	1
Fire clay shale		

Three feet of this black shale with marine fossils is exposed at crop on the opposite side of the river from Colfax, immediately over 14½ inches of Brush Creek coal, at an elevation of 921′ A.T., spirit level. Its crop is also exposed along the north hillside of Tygart Valley river, 0.5 mile northeast of Powell (See Powell section, page 145).

In **Taylor** the crop of the limestone is well exposed in the bed of Lost run in the southwest border of Booths Creek district, 0.5 mile above the mouth of Brush run, at an elevation of 1065′ A.T., aneroid, where it is 3 inches thick and carries many marine fossils.

On the western edge of Courthouse district, Reger measured the following section at the crop of the limestone along the west bank of Tygart Valley river, 1.5 miles south of Grafton, in an old railroad cut:

	Ft.	In.
Shale, brown	15	0
Limestone, marine fossils, prolific, Brush Creek	0	6
Slate, black, Brush Creek	4	0

Fossil Fauna.—Collections of marine fossils were made from this limestone and shale as with the Ames and Pine Creek, in Monongalia, Marion and Taylor counties, and the specimens forwarded to Dr. J. W. Beede for study and classification, who reports as follows thereon:

Brush Creek Limestone Fossils*

Monongalia County, Lock No. 13, B. & N. R. R. Grade:

Astartella gurleyi.
Astartella vera.
Aviculopecten hertzeri.
Aviculopecten Cf. interlineatus.
Aviculopecten Cf. Maccoyi.
Aviculopecten sp.
Bellerophon percarinatus.
Bulimorpha 2 sp.
Bellerophon Cf. stevensanus.
Composita argentia.
Crinoid fragments.
Euomphalus catilloides.
Gastropod.
Leda bellistriata.
Leda attenuata.
Lophophyllum profundum.
Nucula sp.
Nucula sp.
Nucula parva.
Orthonema sp.
Orthoceras sp.
Ostracoda. Many species.
Patellostium montfortianum.
Pelecypod sp.
Pelecypod sp.
Plagioglypta meekana.
Pleurotomaria? sp.
Pleurophorus sp.
Productus cora.
Spirifer cameratus.
Tainoceras occidentalis?
Worthenia Cf. speciosa.
Yoldia sp.

*The letter "a" means that specimens of species were abundant; the letter "c", common; and the letter "r", rare.

Whiteday (Smithtown), West bank of Whiteday Creek: (Fossils fragmentary and poorly preserved).

Ambocoelia planoconvexa.
Astartella? sp.
Astartella gurleyi.
Aviculopecten hertzeri.
Bulimorpha? sp.
Euomphalus catilloides, c.
Leda bellistriata.
Lingula umbonata.
Nautiloid.
Nucula parva.
Orthonema? sp.
Orthoceras? sp.
Ostracoda, six or eight species.
Patellostium? sp.
Pelecypod sp.
Plagioglypta meekana.
Productus cora.

Marion County, West bank Tygart River at Colfax:

Ambocoelia planoconvexa.
Astartella gurleyi.
Astartella vera?
Aviculopecten hertzeri, c.
Bellerophon Cf. stevensanus.
Bellerophon percarinatus.
Bulimorpha? sp.
Chonetes granulifer, a.
Chonetes variolatus.
Derbya crassa.
Euphemus carbonarius.
Euomphalus catilloides, a.
Leda attenuata.
Lophophyllum profundum.
Marginifera splendens, c.
Nucula parva, c.
Nucula ventricosa.
Orothoceras, 1 or 2 species.
Ostracoda, 5 or 6 species.
Patellostium montfortianum.
Plagioglypta?
Pleurotomaria Cf. brazoensis.
Pleurotomaria, 2 species.
Pelecypod, sp.
Pleurophorus sp.
Schizodus suncircularis, c.
Soleniscus brevis.
Tainoceras occidentalis?
Worthenia Cf. speciosa, c.

Taylor County, 1¾ Miles NW of Pruntytown, bed of Lost run:

Aclisina sp.
Astartella gurleyi.

Astartella vera, a.
Aviculopecten? sp.
Bellerophon Cf. stevensanus.
Bellerophon percarinatus, a.
Bellerophon sp.
Bulimorpha sp.
Chonetes sp.
Composita argentia.
Crinoid fragments.
Edmondia? sp.
Orothoceras sp.
Parallelodon sp.
Patellostium montifortianum.
Plagioglypta? sp.
Pleurotomaria 2 sp.
Rhomborpora lepidodendroidea.
Soleniscus brevis.
Soleniscus sp.
Trilobute glabella.

Grafton, 2 Miles south of West Bank of Tygart Valley River:

Acanthopecten carboniferus.
Bellerophon percarinatus.
Bellerophon Cf. stevensanus.
Chonetes sp.
Composita argentia.
Crinoid fragments.
Pleurotomaria sp.
Phillipsia? sp.
Productus nebraskensis.
Strophalosia sp.
Tainoceras occidentalis?

At the end of this chapter is given a tabular list, prepared by Dr. Beede, of the species common to the Brush Creek, Ames and Pine Creek limestones.

The Brush Creek Coal.

The Brush Creek coal of White[19], belonging 5 to 15 feet below the Brush Creek limestone and at the base of the Brush Creek shale, is a thin—6 to 18 inches—single-bedded vein of wide distribution. Its crop follows roughly the same area as that outlined for the Upper Freeport coal on Map II, since it belongs only 75 to 90 feet above the base of the Conemaugh series. Its thickness and relative position in the rock column are exhibited in the sections for VanVoorhis, Morgan Run,

19. Report Q, Second Geol. Survey, Penna.

PLATE XXII(a)—President's Home, West Virginia University, built of Buffalo Sandstone.

PLATE XXII(b)—Methodist Episcopal Church at Morgantown, built of Buffalo Sandstone.

Easton, McClaren, Morgantown and Rock Forge in Monongalia; for Powell in Marion; and for Webster, Grafton, Thornton and Stonehouse in Taylor county.

In **Monongalia** this vein was once stripped out of the bed of the Monongahela river at Morgantown during low water periods before the construction of locks and dams on the latter stream. Southwestward along the axis of the Indiana anticline, this coal rises rapidly and crops near the road fork at the Standard Oil pump station (Scrafford) at an elevation of 860′ A.T., aneroid, where it is only 6 inches thick, directly below the fossiliferous Brush Creek shale, and 10 feet below the Buffalo sandstone. It is 12 inches thick at its crop in the road a short distance west of the residence of Arlington Field, 1.5 miles northeast of Dellslow, at an elevation of 1350′ A.T. On the southwest border of Grant district this coal is 9 to 12 inches thick at its crop along the B. & N. R. R. grade immediately north of Lock No. 13, as shown in the section given above under the discussion of the Brush Creek limestone and shale.

The following section was measured by Reger at its crop along the road on the southwest edge of Clinton district, 0.4 mile south of Whiteday, near the Ed. Watson No. 1 well (344):

	Ft.	In.
Shale, dark fossiliferous	8	0
Coal, Brush Creek (1005′ B-A. T.)	1	6
Shale	15	0
Sandstone, Upper Mahoning, to Watson No. 1 well	15	0

In **Marion** this coal crops on the northeast edge of Grant district, near the west end of the bridge over Tygart Valley river at Colfax, at an elevation of 920′ A.T., spirit level, where a sample of coal was collected for analysis and the following section measured:

Colfax Prospect, Brush Creek Coal—No. 72 on Map II.

	Ft.	In.
Shale, sandy	15	0
Shale, dark, with iron ore nuggets	10	0
Shale, black, marine fossils, Brush Creek	2	6
Coal, Brush Creek	1	2½
Fire clay shale, Brush Creek	10	0
Sandstone, Mahoning, to river		

The composition, calorific value and fuel ratio of the sample are given under **No. 72** (Laboratory No. 572H) in the table of coal analyses. Two miles southeastward the crop of this coal is exposed along the north hillside of Tygart Valley river, 0.5 mile northeast of Powell where it is 8 to 12 inches thick (See Powell section, page 145).

In **Taylor** the following section was measured at an opening in this bed in the northwest border of Fetterman district, 1.3 miles northeast of Coffman:

L. D. Phillips Mine, Brush Creek Coal.

	Ft.	In.
Sandstone, massive, Buffalo	40	0
Concealed	10	0
Slate, black, fossil plants, Brush Creek	5	0
Coal, Brush Creek	1	4½
Fire clay shale		
(Elevation of coal, 1190′ B-A. T.)		

This opening furnished domestic fuel for Mr. Phillips.

In Booths Creek district, this coal has been opened on the land of John Jeffries at the west edge of the private road on Jack run, 1 mile east of McGee, at an elevation of 1185′ A.T., aneroid, where the following section was measured:

		Ft.	In.
1.	Concealed		
2.	Shale, black, fossiliferous, Brush Creek	3	6
3.	**Coal, good Brush Creek**	1	6
4.	Fire clay shale	0	3
5.	Concealed	20	0
6.	Sandstone, massive, coarse, pebbly, Mahoning	50	0

Three-fourths mile southward, near the road fork at the mouth of Rush run, the Brush Creek coal—16 inches thick—crops along the road at an elevation of 1076′ A.T., aneroid, 76 feet by hand-level below the fossiliferous Pine Creek limestone. As mentioned on a preceeding page, the fossiliferous Brush Creek limestone crops in the bed of Lost run, 0.3 mile southwestward.

In the northwest corner of Knottsville district, Reger measured the following section at the crop of this coal near the **Newton Grimes No. 1 well (722)**, 0.5 mile southeast of Grafton:

	Ft.	In.
Sandstone, massive, Buffalo	40	0
Shale, black, fossil plants, Brush Creek	4	0
Coal, Brush Creek	0	6
Concealed to **Grimes No. 1 well (722)**	10	0
Sandstone, massive, Upper Mahoning	30	0
Shale, gray		

(Elevation of coal, 1120′ A. T., aneroid).

The same coal is 10 inches thick at its crop at the foot of the hill road on the west bank of the Tygart Valley river, 1 mile northeast of Webster, at an elevation of 1020′ A.T. aneroid.

In the southeastern edge of Courthouse district this vein crops along the road at the intersection of Pleasant creek with the Taylor-Barbour county line, at an elevation of 1155′ A.T., aneroid, where the following section is exposed:

	Ft.	In.
Sandstone, Buffalo	40	0
Concealed	15	0
Coal, slaty, Brush Creek	0	6
Fire clay shale	3	0
Sandstone, Mahoning, to creek	30	0

Northeastward in the southern point of Knottsville district this coal—8 inches thick—crops in the road 0.5 mile north of Cecil, at an elevation of 1245′ A.T., aneroid, about 110 feet below the Bakerstown coal at the Shroyer mine—No. 71 on Map II. Eight-tenths mile northeast of Hiram, an abandoned opening occurs in this coal on the land of Geo. McCartney Heirs, near the road fork on the north side of Glade run, at an elevation of 1440′ A.T. The opening had fallen shut; hence, no section was obtained.

In the northeastern corner of Knottsville district the Brush Creek coal was once opened on the land of John W. Thomas, 0.6 mile southwest of Eby, at an elevation of 1525′ A.T., aneroid, 175 feet below the Harlem coal. Mr. Thomas reports the bed 30 inches thick with 3 or 4 inches of hard coal on top.

From the foregoing data it is readily observed that the Brush Creek coal is too thin, impure and irregular to be classed as a minable bed.

At many points in the three counties there occurs a fairly

pure fire clay shale immediately below the last coal described, ranging in thickness from 5 to 10 feet. A sample of this clay was collected for analysis and the following section measured at its crop near the foot of the hill road on the west bank of Tygart Valley river, 1 mile northeast of Webster:

	Ft.	In.
Shale	4	0
Slate, black, fossil plants Brush Creek	4	0
Coal, Brush Creek	0	10
Fire clay shale, good	10	0

(Elevation of coal, 1020′ A. T., aneroid).

The composition of the sample is reported by Messrs Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	53.54
Ferric Iron (Fe_2O_3)	4.64
Alumina (Al_2O_3)	26.34
Lime (Ca O)	0.10
Magnesia (Mg O)	0.70
Soda (Na_2O)	0.39
Potassa (K_2O)	3.76
Titanium (TiO_2)	0.59
Phosphoric Acid (P_2O_5)	0.20
Moisture	1.87
Loss on ignition	7.68
Total	99.71

The results show a clay adapted to the manufacturing of building and paving brick.

The Mahoning Sandstone Stage.

At 5 to 25 feet below the Brush Creek coal there belongs almost universally a massive sandstone group, frequently in one massive solid ledge, 80 to 100 feet thick, but sometimes separated into two sandstones by an intervening coal and an underlying fire clay; so that when all the members are represented, the Mahoning stage is made up of the following succession:

Upper Mahoning sandstone.
Mahoning coal.
Thornton fire clay.
Lower Mahoning sandstone

The Mahoning Sandstones.—The sandstone members of this stage along with the overlying Buffalo sandstone play a conspicuous part in shaping the topography of the area; in fact, as mentioned under the description of the latter stratum, the Mahoning and Buffalo sometimes coalesce into one great unbroken cliff as exhibited along the B. & O. R. R. grade between Morgantown and Uffington, Monongalia county. The "Big Dunkard sand" of the oil and gas well drillers belongs at this horizon. Their crop follows closely the area outlined on Map II for the crop of the Upper Freeport coal; and their thickness, character and relative position in the rock column are exhibited in the sections for Morgan Run, Morgantown, Sabraton, Aaron Creek, Rock Forge, Little Falls and Triune in Monongalia; for Glover Gap, Whetstone Run, Downs, Montana Mines and Powell in Marion; and for Grafton, Irondale, Thornton and Cecil in Taylor county.

In **Monongalia** the Mahoning rises above Cheat river at Ices Ferry, and is there represented by the prominent cliff at the west end of the highway bridge over the latter stream. The rapid southeast rise of the strata on the western slope of the Chestnut Ridge anticline from the latter point causes these sandstones to pass into the air over the high mountain summits within two miles. Along the Monongahela it crops above river level along the crest of the Indiana anticline at Uffington and Little Falls as exhibited in the sections on preceding pages for these points. The wing walls of the dam at Lock No. 13 on the latter stream, one mile northwest of Little Falls, rest on the Mahoning sandstones.

In **Marion** these sandstones first rise above drainage on Tygart Valley river at Colfax as exhibited in the section there under the description of the Brush Creek coal. Southeastward along this stream to near Hammond they have coalesced into one great unbroken cliff—60 feet high—forming the valley walls (See Powell section, page 145).

In **Taylor** the Mahonings attain the same development on the opposite side of the river from the last locality mentioned. The rapid dip of the strata on the eastern slope of the Chestnut Ridge anticline causes these sandstones to pass below this stream a short distance above the mouth of Wickwire run,

again to emerge at Grafton. The "Black Falls" or shoals in the river, south of Grafton and 0.5 mile below the mouth of Scab run, are formed by the Mahoning, where it is massive, gray, hard and pebbly, weathering to a brownish color. One-half mile southward it has been quarried to a small extent at the mouth of Scab run.

The Mahoning Coal.—The Mahoning coal of White[20], belonging immediately below the Upper Mahoning sandstone, was not observed either at crop or in the logs of several diamond drill borings penetrating the same; however, a streak of dark shale and fire clay was noted at this horizon along the B. & O. R. R. grade between Scrafford and Uffington in Monongalia.

The Thornton Fire Clay.—The Thornton fire clay of White[21], belonging immediately under the Mahoning coal and 30 to 40 feet above the base of the Conemaugh series, is very irregular in thickness, very frequently absent entirely, but when present is fairly pure. It attains its best development at Thornton, its type locality in eastern Taylor county, where it has been mined quite extensively by the Thornton Fire Brick Company to furnish the raw clay for their plant. Here the clay has apparently entirely replaced the Lower Mahoning sandstone (See Thornton section, page 154). Samples were collected at Thornton by Reger for analysis, the composition and properties of which are given in detail under "Clay" on a subsequent page.

This fire clay, several feet in thickness and of good quality, is finely exposed along the bed of Threeforks creek in western Preston county, 0.2 mile southwest of Brown's Mills, 45 feet below the Brush Creek coal and immediately under the Upper Mahoning sandstone; hence, in this portion of the State, it appears quite persistent. This formation furnishes part of the raw clay used in the brick plant at Colfax, Marion. There Reger collected a sample for analysis, the composition of which is given under "Clay" in a subsequent chapter.

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20. I. C. White, Bull. No. 65, U. S. G. Survey, p. 94; 1891.
21. I. C. White, Vol. II, W. Va. Geol. Survey, pp. 322-323; 1903.

The Uffington Shale.

The basal formation of the Conemaugh series is the **Uffington shale** so designated by I. C. White[22] from a town of that name in Monongalia county, where it is a dark, sandy and fossiliferous shale, varying in thickness from 20 to 40 feet and occupying the interval between the Lower Mahoning sandstone and the Upper Freeport coal. Here the shale contains marine fossils as well as many plant remains, and it was from this locality that most of the specimens were collected by J. J Stevenson that are listed on pages 324-325 of Vol. II. of the State Survey reports as follows:

List of Fossils from Uffington Shales Near Morgantown.

*Crinoidal columns.
Erisocrinus. Undetermined species.
*Deltopecten carbonarius Stevenson sp.
Allorisma. Undetermined species.
*Nucula ventricosa Hall.
†Nucula anodontoides Meek.
*Leda atetnuata Stevenson sp.
†Yoldia carbonaria Meek.
†Yoldia stevensoni Meek.
*Schizodus. Undetermined species.
*Edmondia aspenwalensis Meek.
Astartella. Undetermined species.
Sphaerodoma primigenia Conrad.
*Soleniscus brevis Hall.
Sphaerodoma? Undetermined species.
Bulimorpha? peracua Meek and Worthen.
*Euomphalus catilloides Conrad.
*Patellostium montfortianus Norwood and Pratten.
*Bellerophon percarinatus Conrad.
*Euphemus carbonarius Cox.
Bucanopsis meekiana Swallow.
*Pleurotomaria grayvilliensis Norwood and Pratten.
*Orthoceras cribrosum Geinitz.
*Tainoceras occidentalis Swallow.
*Phillipsia sangamonensis Meek and Worthen.
*Productus nebrascensis Owen.
*Productus cora D'Orbigny.

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22. Vol. II, W. Va. Geol. Survey, pp. 323-325, 1903.

*Species known to range through the whole of the Coal Measures in the West, even into the upper beds at Nebraska City, Nebraska, referred by Profs. Marcou and Geinitz to the Permian or so-called Dyas.

†New species.

*Composita argentia Stevenson. Presenting all the usual varieties.
Productus. Species undetermined. Very small, concentrically wrinkled.
*Ambocoelia planoconvexus Shumard.
*Spirifer cameratus Morton.
Aviculapecten? Undetermined species. Probably Deltopecten occidentalis Shumard.
*Derbya crassus Meek and Hayden.

The crop of this shale should follow very closely the same area as that outlined for the Upper Freeport coal on Map II. Its thickness and relative position in the rock column are exhibited in the sections for VanVoorhis, Aaron Creek and Uffington in Monongalia, and for Stonehouse in Taylor county. It is not at all persistent, as often the Lower Mahoning sandstone lies in immediate contact with the Upper Freeport coal. At Thornton the overlying Thornton fire clay has replaced this shale entirely.

FOSSIL FAUNA, CONEMAUGH SERIES.

As mentioned on preceding pages under the descriptions of the Ames, Pine Creek and Brush Creek limestones, a tabular list of the species collected from these formations has been prepared by Dr. Beede, omitting some of the uncertain and undetermined species, which would increase the total number shown in the table. This list which follows exhibits a total of 71 different species many of which are common to all three of the limestones. The Ames and Brush creek rank about equal in the variety of forms shown therein, both revealing a greater diversity of animal life than the Pine Creek:

Marine Fossils from Three Conemaugh Limestones in the Monongalia-Marion-Taylor Aera.	Ames.	Pine Creek.	Brush Creek.
Endothyra sp	x	..	..
Lophophyllum profundum	..	x	x
Crinoid fragments	a	a	x
Serpula? sp	x	..	..
Bryozoan sp	..	x	..
Rhombopora lepidodendroidea	..	x	x
Ambocoelia planoconvexa	a	x	c
Chonetes granulifer	c	x	c
Chonetes variolatus	r	x	x
Composita argentia	a	x	x
Derbya crassa	c	x	x
Lingula umbonata	..	..	r

	Ames.	Pine Creek.	Brush Creek.
Marginifera splendens	..	..	c
Productus cora	x	x	x
Productus nebraskensis	c	x	..
Productus pertenuis??	x	..	..
Productus Cf. semireticulatus	..	x	..
Rhipidomella pecosi	x	..	..
Spirifer cameratus	x	..	x
Strophalosia sp.	x	..	..
Allorisma geinitzi??	r	..	..
Astarteila gurleyi	c	..	x
Astartella vera	r	..	x
Aviculopecten hertzeri	..	..	c
Aviculapecten Cf. interlineatus	..	..	x
Aviculopecten sp.	r	..	..
Aviculopecten? sp.	..	..	x
Aviculopinna americana?	r	..	..
Deltopecten McCoyi	..	..	?
Deltopecten occidentalis	x	..	..
Edmondia aspenwallensis?	x	..	..
Leda bellistriata	x	..	x
Leda attenuata	c	..	x
Myalina subquadrata	x	..	..
Nucula parva	c	..	c
Nucula sp	x	..	x
Nucula ventricosa	?	..	x
Parallelodon tenuistriata?	..	..	x
Pleorophorus oblongus?	r	..	..
Schizodus suborbicularis	..	..	x
Solenomya trapezoides?	r	..	..
Yoldia sp.	x	..	..
Aclisina sp.	x	..	..
Aclisina swallowana	x	..	..
Bellerophon percarinatus	x	..	c
Bellerophon stevensanus	r	..	..
Bellerophon sp.	..	..	x
Bulimorpha chrysalis	x	..	..
Bulimorpha sp. a	x	..	x
Bulimorpha sp.	x	..	..
Euomphalus catilloides	x	x	c
Euphemus carbonarius	x	x	c
Loxonema scitulum	r	..	..
Loxonema rugosum	r	..	..
Loxonema semicostatum	r	..	..
Orthonema quadricarinatum	x	..	..
Orthonema Cf. subtaeniatum	r	..	r
Orthonema? sp.	r	..	r
Patellostium Montfortianum	c	..	x
Plagioglypta meekana	..	..	x
Pleurotomaria Cf. brazoensis	x	..	x
Soleniscus brevis	x	..	x
Soleniscus paludinaeformis	x	..	..
Sphaerodoma primingenia?	x	..	..
Worthenia Cf. speciosa	x	..	c
Orthoceras rushensuis?	x	?	x
Tainoceras occidentalis	?	..	?

	Ames.	Pine Creek.	Brush Creek.
Nautiloid	..	..	r
Ostracoda	x	..	x
Phillipsia major?	..	..	?
Fish tooth	..	r	..

"In the right hand columns of the above list, the "a" signifies that the specimens of the species were abundant; the "c", that they were common, that is, present in numbers; the "r" and "x", rare to fairly numerous."

CHAPTER VIII.

STRATIGRAPHY—ALLEGHENY SERIES.

The Allegheny series begins at top with the Upper Freeport coal and extends down in the rock column to the top of the Homewood sandstone. An interesting account of the same in West Virginia is given by I. C. White on pages 333-341 of Vol. II of the State Survey reports. The crop of these rocks in the area under discussion, as shown in detail on Map II, is confined to the eastern portions of Monongalia and Marion counties, and the central and eastern portions of Taylor. Their thickness ranges from 220 to 275 feet.

SECTIONS.

The following is a general section of the Allegheny in West Virginia:

General Section, Allegheny Series in West Virginia.

	Thickness. Feet.	Total. Feet.	
Coal, Upper Freeport	5	5	
Fire clay, Bolivar	10	15	
Limestone, Upper Freeport	5	20	
Sandstone, Upper Freeport, containing some times **Middle Freeport coal**	40	60	
Coal, Lower Freeport	2	62	62′
Fire clay and shale	3	65	
Limestone, Lower Freeport	5	70	
Sandstone, Lower Freeport, upper division	40	110	
Coal, Upper Kittanning	4	114	52′
Fire clay shale	6	120	
Limestone, Johnstown (cement)	4	124	
Fire clay, Hardman	6	130	
Sandstone, Lower Freeport, lower division	30	160	
Coal, Middle Kittanning	2	162	
Shale, sandy	18	180	
Coal, Lower Kittanning	5	185	71′
Fire clay, Lower Kittanning	5	190	
Shale, with iron ore nuggets	30	220	

	Thickness. Feet.	Total. Feet.	
Limestone, Vanport (Ferriferous)	2	222	
Sandstone, Clarion	20	242	
Coal, Clarion	3	245	
Fire clay, Clarion	5	250	65′
Sandstone, massive, Homewood			

The succession and character of the strata of the Allegheny series in this area are exhibited in the general sections given in Chapter IV and the two following widely separated sections measured at crop:

Dellslow Section, Allegheny Series.

	Thickness. Feet.	Total. Feet.	
Coal, bony....2′ 6″			
Coal, soft....3 0			
Slate, dark gray, 2″ to.0 3			
Coal 1 0	(13′ 6″)		
Slate, dark gray, 1″ to.0 2	Upper		
Coal 0 2	Freeport		
Shale, gray....5 0	coal	13.5	13.5
Coal 0 10			
Shale, dark gray....0 2			
Coal 0 5			
Fire clay, Bolivar		3	16.5
Limestone, silicious and shaly, Upper Freeport		5.5	22
Shale		5	27
Concealed		31	58
Shale, sandy, with thin sandstones		15	73
Coal, Lower Freeport, 6″ to		1	74	74′
Fire clay shale		5	79
Sandstone, with shale layers		6	85
Shale, gray		4	89
Limestone, silicious, broken, Lower Freeport, 0′ to		3	92
Sandstone, massive, lenticular, 1′ to		4	96
Shale, with thin flaggy sandstones and iron ore nuggets		14	110
Black sandy slate		0.1	110.1
Coal, Upper Kittanning		0.7	110.8	36.8′
Fire clay and gray shale		3.2	114
Sandstone, massive, limy, nodular		4	118
Shale, dark gray		7	125
Coal, slaty at bottom, Middle Kittanning		1	126	15.3′
Shale, dark, sandy, laminated with many small iron ore nuggets		4	130
Shale, dark gray		7	137
Slate, black		2	139
Shale, sandy and dark		2	141
Concealed		5	146
Coal (old digging fallen shut), Lower Kittanning		4	150	24′
Concealed			

In the above section that portion above the Upper Kittanning coal was measured with hand-level along the Morgantown & Kingwood Railroad grade west of Dellslow station, and the lower portion from exposures along the same grade south of the latter station. Owing to the intervening ravine and rapid southeast dip of the strata it was quite difficult to connect the two parts of the section.

The following section was measured with aneroid by Reger eastward in descending order to near the residence of Granville Brown, near Halleck, Monongalia county, along the rapid dip of the strata; hence, thicknesses of formations and intervals are greater than they should be:

Section 1.4 Miles N. of Halleck, Allegheny Series.

	Thickness. Feet.	Total. Feet.
Coal, Upper Freeport, concealed, but thickness supplied by Granville Brown.....	3	3
Concealed	90	93
Coal opening, thickness concealed, Lower Freeport	0	93
Concealed with sandstone.....	65	158
Coal, thickness concealed, Upper Kittanning	0	158
Concealed	43	201
Shale, dark.....	9.5	210.5
Coal .....1′ 6″ } **Lower Kittanning** Slate, black....0 3 } **coal** ..... Coal, soft.....0 8 } (Elevation, 1800′ B-A. T.)	3.5	214
Slate and concealed.....	45	259
Iron ore, Buhrstone 12″ to.....	1.5	260.5
Concealed	9.5	270
Sandstone, massive, white, Homewood.....		

DESCRIPTION OF ALLEGHENY FORMATIONS.

The Upper Freeport Coal.

The topmost formation of the Allegheny series is the **Upper Freeport coal bed** which was designated by the First Geol. Survey of Penna. from the town of Freeport in western Pennsylvania, where it is a multiple-bedded seam, a characteristic feature that accompanies it everywhere in West Virginia. As shown in detail on Map II its crop is confined to the eastern portions of Monongalia and Marion counties, and the central and eastern portions of Taylor. In this portion of the

State the coal has a peculiar structure which so distinctly characterizes it that the bed may be identified thereby with a fair degree of certainty. A series of parting slates or shales subdivide the vein into several definite members which may be grouped as follows:

1. Top coal.
2. Main bench.
3. Parting—Little Slate.
4. Lower bench—Mining Ply.
5. Parting—Big Slate.
6. Bottom coal.

At present there are three commercial mines in the area, and all are located along Deckers creek in Monongalia, being driven directly on the crop of the bed. The following is a general type section of the coal as exhibited at these mines:

	Ft.	In.
1. Coal, hard, sulphurous "top"	1	6
2. Coal, soft, "main bench"	2	10
3. Slate, "little"	0	2
4. Coal, soft, with thin slate 2" above bottom, "mining ply"	1	3
5. Slate, dark gray, "big slate" 12" to	5	0
6. Coal, hard, sulphurous, "bottom"	1	3
Total	12	0

The "main bench" and "mining ply" are much lower in sulphur than the other portions of the bed, and it is from these divisions that the high grade coking coal is taken.

As a minable seam this vein appears to be confined almost entirely to the eastern portion of the area, and on Map II the "Approximate western boundary line where the Upper Freeport coal of commercial thickness and purity disappears" is shown by a heavy line of dots in blue. There may be small areas of this bed of minable thickness to the west of this line, but they will prove extremely limited in extent, as revealed both from crop and the borings of a great number of wells for oil and gas. Likewise, there may prove to be some small areas to the east of this line in Marion and Taylor counties, and the southern point of Clinton district, Monongalia, where the coal has thinned below minable dimensions, since in these localities it appears to be more or less irregular.

The thickness and relative position of the Upper Freeport coal in the rock column are exhibited in the sections in Chap-

ter IV for VanVoorhis, Mt. Chateau, McClaren, Morgantown, Sabraton, Aaron Creek, Rock Forge, Little Falls, Clinton Furnace, Triune, and Anita in Monongalia county; for Powell in Marion; and for Thornton and Stonehouse in Taylor. Its character, composition, calorific value and fuel ratio will be discussed fully in Chapter XII along with an estimate of the probable minable area and tonnage of the bed by magisterial districts.

The Bolivar Fire Clay.

The **Bolivar fire clay** lies immediately below the last described coal and has been so named from a town in Westmoreland county, Pa., where it has long been the basis of an important fire brick industry. It is generally a hard, flinty clay, ranging in thickness from 5 to 20 feet, and often replacing the Upper Freeport limestone.

In **Monongalia county** this clay has been opened and tested along Deckers creek, according to I. C. White[1], on the Pixler farm where the bed contains some very good hard flint clay as well as several feet of soft plastic clay.

In the southern portion of Clinton district a high grade flint clay with a thickness of 6 feet crops apparently at this horizon in the public road on the Mary Rogers farm, 0.2 mile northwest of the common corner to Monongalia, Marion and Taylor counties, at an elevation of 1905'A.T., aneroid, about 120 feet above an opening in the Lower Kittanning coal, where a sample for analysis was collected, the composition of which is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	58.99
Ferric Iron ($Fe_2 O_3$)	3.01
Alumina (Al_2O_3)	24.95
Lime (Ca O)	1.08
Magnesia (Mg O)	0.11
Soda (Na_2O)	0.13
Potassa (K_2O)	0.45
Titanium ($Ti O_2$)	0.78
Phosphoric Acid (P_2O_5)	0.09
Moisture (H_2O)	1.92
Loss on ignition	8.58
Total	100.09

1. Vol. II, W. Va. Geological Survey, p. 462; 1903.

For the same reasons assigned below for this clay near Thornton, the results show a fine clay for any product requiring high refractory qualities. Judging from the relative percentages of alumina and ferric iron, the clay would burn to a buff color.

In **Marion** this clay attains a good development in the eastern point of Winfield district. A sample for analysis was collected at its crop in the public road, 0.5 mile northeast of "Moran Schoolhouse" at an elevation of 1705'A.T., aneroid, where it is quite flinty, and 6 to 8 feet in thickness. The composition of the sample is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica (SiO_2)	68.75
Ferric Iron (Fe_2O_3)	2.06
Alumina (Al_2O_3)	19.60
Lime (CaO)	0.70
Magnesia (MgO)	0.03
Soda (Na_2O)	0.04
Potassa (K_2O)	0.41
Titanium (TiO_2)	0.64
Phosphoric Acid (P_2O_5)	0.15
Moisture (H_2O)	1.11
Loss on ignition	7.34
Total	100.83

Although slightly higher in silica and lower in alumina than the samples for Monongalia and Taylor, yet the relatively low percentage—4.03—of fluxing constituents classes it as a highly refractory clay, adapted to the manufacture of fire brick and other heat resisting products.

In **Taylor** this clay of a flint type attains a fine development along the northern border of Fetterman district, southeastward to Irondale from the common corner to Monongalia, Marion and Taylor counties. In this region it is 5 to 10 feet in thickness as exposed at crop along the ridge roads, and of extra fine quality.

In the southeast portion of Fetterman district this clay attains fair development along Threeforks creek near Thornton as exhibited in the section for the latter place, page 154. Two-fifths mile southeastward Reger collected a sample for

analysis and measured the following section at its crop at the U. G. Jennings coal mine on the east side of the Northwestern turnpike:

		Ft.	In.
1.	Sandstone, massive, Mahoning	30	0
2	Slate, black	3	0
3.	Coal, Upper Freeport, with partings	5	1¾
4.	Fire clay, plastic, light, Bolivar	10	0

The composition of the sample from No. 4 of section is reported by Messrs. Hite and Krak as follows:

	Per cent.
Silica ($Si O_2$)	57.43
Ferric Iron (Fe_2O_3)	3.06
Alumina (Al_2O_3)	26.59
Lime (Ca O)	0.27
Magnesia (MgO)	0.16
Soda (Na_2O)	0.23
Potassa (K_2O)	1.98
Titanium ($Ti O_2$)	0.53
Phosphoric Acid (P_2O_5)	0.26
Moisture	1.18
Loss on ignition	8.25
Total	99.94

The results reveal a clay adapted to the manufacture of both building and fire brick. The comparatively low percentage of the fluxing elements to that for the silica, alumina and water indicates a clay with high refractory qualities, and one that would burn into a yellowish brown or buff colored product.

The Upper Freeport Limestone.

The **Upper Freeport limestone,** ranging in thickness from 5 to 15 feet, and having a wide distribution in Pennsylvania, belongs 5 to 20 feet below the Upper Freeport coal in northern West Virginia where it is quite irregular. It is a fresh or brackish water deposit as no marine fossils have ever been observed therein. Its crop should follow closely the same area as that outlined for the crop of the Upper Freeport coal on Map II. Its thickness and relative position in the rock

column are exhibited in the sections for Morgan Run in Monongalia, and for Thornton and Stonehouse in Taylor county.

In **Monongalia county** this stratum was once quarried on Deckers creek near Dellslow where the uppermost layers are frequently changed into carbonate of iron and were used in the old furnace there. In this region it has the following chemical composition according to G. P. Grimsley[2]:

	Per cent.
Lime carbonate	88.21
Magnesium carbonate	3.05
Silica	3.80
Alumina and iron	4.97

In **Marion** the crop of this limestone was observed along the southwest border of Winfield district, 0.4 mile south of Canton (Winfield) where samples were collected for analysis and the following section measured by Reger:

		Ft.	In.
1. Sandstone, shaly, Mahoning			
2. Coal, soft, slaty..2′ 6″			
3. Shale, gray.....0 1	Upper Freeport coal..	4	10
4. Coal 1 4			
5. Fire clay, gray		7	0
6. Slate, dark coaly		1	6
7. Shale, gray, silicious		6	0
8. Iron ore.....1′ 0″	Upper Freeport		
9. Limestone 2 0	Limestone	3	0

The composition of the samples from Nos. 8 and 9 of the section is reported by Messrs. Hite and Krak as follows under Lab. Nos. 621H and 622H, respectively:

	No. 8. Per cent.		No. 9. Per cent.
Silica ($Si O_2$)	14.84	Silica ($Si O_2$)	12.17
Metallic Iron	38.99	Ferric Iron (Fe_2O_3)	18.17
Lime ($Ca O$)	4.81	Alumina (Al_2O_3) (none)	0.00
Sulphur	1.31	Calcium Carbonate ($Ca CO_3$)	53.32
Phosphorus	0.36	Magnesium Carbonate ($Mg CO_3$)	7.66
		Phosphoric Acid (P_2O_5)	0.67
		Loss on ignition	7.36
		Total	99.35

2. Vol. III, W. Va. Geol. Survey, p. 349; 1905.

In **Taylor** this limestone attains a fair development along the eastern border of Fetterman district. Just across the county line in Preston this ledge was once quarried quite extensively both for ore and fluxing material for use in the old iron furnaces near Irondale. Its composition and character there will be given in a report now under preparation by the Survey for Preston county.

The Upper Freeport Sandstone.

In the interval between the Upper and Lower Freeport coals there frequently belongs a massive, arenaceous stratum, 15 to 40 feet in thickness, that has been termed the **Upper Freeport sandstone** in contradistinction to the Lower Freeport sandstone below. It crops over practically the same area as that outlined for the Upper Freeport coal bed on Map II. Its thickness, character and relative position in the rock column are exhibited in the sections for Cassville, VanVoorhis, Morgan Run, Sabraton, Aaron Creek and Rock Forge in Monongalia; for Powell in Marion; and for Grafton and Cecil in Taylor county. On the southwest border of Knottsville district, Taylor, this ledge has been quarried extensively for building purposes by Grafton parties along the Grafton & Belington Branch of the B. & O. R. R., 0.3 mile southeast of Stonehouse on the land of McDaniel Heirs, at an elevation of 1060′A.T., aneroid, where the following section was measured by Reger:

		Feet.
1.	Sandstone, massive, Mahoning	20
2.	Fire clay and spring, Upper Freeport coal horizon	1
3.	Concealed	29
4.	Sandstone, broken....10′	
5.	Sandstone, hard, massive, quarry rock...20 } Upper Freeport Sandstone	30
6.	Coal, streak Lower Freeport	0
7.	Concealed to Valley river	70

"No. 5 of section, the quarry rock, is hard, massive, gray, very coarse-grained with small quartz pebbles, weathering to brown. It seems very durable and makes prominent cliffs on both sides of Tygart Valley river. Bedding and joint planes are far apart and large blocks can be split without difficulty. Joint planes extend through the quarry at an angle of about 60° with the vertical. Product used for bridge work and retaining walls, and shipped to Fairmont and Grafton. The stone used in the bridge over Threeforks creek at the latter city came from this quarry."

No other quarries were observed on this ledge.

The **Middle Freeport coal**, belonging 25 to 35 feet below the Upper Freeport bed, was not observed at crop in the area, but the coal test borings used in connection with the Aaron Creek and Sabraton sections, pages 119 and 118, respectively, place its horizon in the body of the Upper Freeport sandstone in a manner similar to that occupied by the Kittanning coal in the Lower Freeport sandstone at the later coal's type locality.

The Lower Freeport Coal.

The **Lower Freeport coal** of the First Geological Survey of Pa., belonging 45 to 75 feet below the top of the Allegheny series, is a multiple-bedded seam of wide but irregular distribution in West Virginia. Its crop roughly follows the region outlined for the crop of the Upper Freeport coal on Map II. Its thickness and relative position in the rock column are exhibited in the sections for Morgan Run, Mt. Chateau, Beaver Hole, Morgantown, Sabraton, Aaron Run, Rock Forge, Clinton Furnace and Anita in Monongalia; for Downs and Powell in Marion; and for Webster, Grafton, Thornton SW, Stonehouse, Bennett No. 2 Bore Hole and Cecil in Taylor county. Judging from its exposures at crop and from these several sections the bed is too thin and irregular to be classed as a minable vein.

The Lower Freeport Limestone.

The **Lower Freeport limestone** belongs 5 to 10 feet below the last coal described, and, like the Upper Freeport limestone above, it contains only univalve fossils, indicating its fresh water origin. It very much resembles the latter limestone both in color and physical appearance. Its crop follows closely the area outlined for the Lower Freeport coal. Its thickness and relative position in the rock column are indidicated in the sections for Morgan Run, Clinton Furnace and and Dellslow in Monongalia.

A sample for analysis was collected at its crop at Clinton

Furnace (See Clinton Furnace section page 123), the composition of which is reported by Messrs. Hite and Krak as follows under Lab. No. 672H:

	Per Cent
Silica (Si. O_2)	6.57
Ferric Iron (Fe_2 O_3)	5.53
Alumina (Al_2 O_3)	3.80
Calcium Carbonate (Ca CO_3)	78.92
Magnesium Carbonate (Mg CO_3)	1.87
Phosphoric Acid (P_2O_5)	0.22
Loss on ignition	3.29
Total	100.20

The results show it too high in sandy and clayey matter to burn into a good commercial lime. The ledge is too thin and irregular to have much value for natural cement utilzation, but it should furnish a limited amount of fair road material.

On the northern edge of Knottsville district, Taylor county, Reger collected a sample of what appears to be this limestone and measured the following section on the south bank of Threeforks creek, 0.2 mile southwest of Thornton:

		Feet.
1.	Sandstone, shaly	15
2.	Shale, limy	2
3.	Sandstone, massive	4
4.	Shale, limy	1
5.	Sandstone, massive, Upper Freeport	15
6.	Sandstone, limy	10
7.	Limestone, yellow....2′	
8.	Limestone, brecciated to railroad grade...15 } Lower Freeport	17

(Elevation of base section, 1055′ A. T., spirit level).

The composition of the sample from No. 7 only of section is reported by Messrs. Hite and Krak as follows under Lab. No. 570H:

	Per cent.
Silica (Si O_2)	22.83
Ferric Iron (Fe_2 O_3)	9.73
Alumina (Al_2O_3)	7.17
Calcium Carbonate (Ca CO_3)	47.30
Magnesium Carbonate (Mg CO_3)	6.43
Phosphoric Acid (P_2O_5)	0.26
Loss on ignition	5.32
Total	99.04

The results show this sample much higher in impurities than that for Clinton Furnace above.

The Lower Freeport Sandstone.

The **Lower Freeport Sandstone,** belonging 5 to 15 feet below the Lower Freeport coal and ranging in thickness from 30 to 100 feet, is the most persistent sandstone of the Allegheny series, and was designated by Lesley from its crop in bold cliffs near Freeport, Pennsylvania. It is usually grayish white, very hard, micaceous, often pebbly, and massive, splitting unevenly; hence, it is not well adapted to quarrying for building stone. At its type locality in Pennsylvania it frequently carries a coal bed near its middle; viz., the Upper Kittanning. In northern West Virginia this sandstone is generally divided into two divisions—upper and lower—by the same coal, the Johnstown (cement) limestone and the Hardman fire clay. The thickness, character and relative positions of these divisions in the rock column are exhibited in the sections for St. Cloud, Cassville, Van Voorhis, Morgan Run, Beaver Hole, Morgantown, Clinton Furnace, and Anita in Monongalia; for Glover Gap, Montana Mines and Powell in Marion; and for Webster, Stonehouse and Cecil in Taylor county. Some gas is often found in this formation; hence the term "gas sand" by the oil and gas well drillers. This sandstone crops in bold cliffs along the steep western slope of the Chestnut Ridge anticline across Monongalia and Marion counties, and in the northern and southeast portions of Taylor, where it is often mistaken for the Homewood at the top of the Pottsville series. It is the Lower Freeport that forms the shoals in Tygart Valley river at Stonehouse in Taylor, and the "rock city" along the west bank of the same stream, 0.5 mile southeastward.

No quarries were observed on this ledge.

The Upper Kittanning Coal.

The **Upper Kittanning Coal** is of some importance in this area. Its stratigraphic horizon is between the upper and lower divisions of the Lower Freeport sandstone, from 90 to

120 feet below the Upper Freeport coal and from 40 to 60 feet above the Lower Kittanning. It is irregular in its distribution, often being absent entirely from the measures, and when present seldom exceeds 4 feet in thickness at its outcrop, although several oil well records in Cass district, Monongalia county, and in western Taylor county give it a greater thickness, in which it is probable that the overlying slate is included. It is double-bedded, invariably carrying a thin slate parting about ten inches from the bottom, and often has a black, lustrous, cannel slate immediately over the top. The following is a type section:

		Ft.	In.
1.	Sandstone, massive, Lower Freeport.....	..	..
2.	Slate, black, cannel.....	0	6
3.	Coal, good, soft...2′ 6″		
4.	Slate, gray ..1″ to 0 2	3	6
5.	Coal, good.....0 10		

In Monongalia county its crop is confined to Union, Morgan and Clinton districts; in Marion, to Winfield and Union districts; and in Taylor to Booths Creek, Feterman and Knottsville districts. Its short interval from the Lower Kittanning coal, the crop of which appears on Map II, will readily determine where it occurs above drainage.

In Chapter IV it is described in the sections for Van Voorhis, Morgan's Run, Morgantown, Aaron Creek, Rock Forge, Clinton Furnace, Powell, Webster, Irondale, Southwest of Thornton, Bennett No. 2 Coal Test and Cecil.

In **Monongalia county** a considerable area of this coal is recorded by oil well records on both sides of the Monongahela river in Cass, Union and Morgan districts, a table of which will be found in chapter XII. At its crop in Union and Morgan districts the coal is not of commercial dimensions, but a considerable thickness was observed at the head of Booths Creek and near Halleck in Clinton district. A section made by Reger at the Emory Jones mine, 1.5 miles south of Clinton Furnace, shows the following structure:

Emory Jones Mine, Upper Kittanning Coal. No. 82 on Map II.

		Ft.	In.
1.	Shale, gray, with streaks of sandstone.....	..	..
2.	Slate, black, cannel	0	8
3.	Coal, good.....1′ 8″		
4.	Slate 0 1	2	6
5.	Coal, good.....0 9		

(Elevation, 1500′ A. T. Aneroid.)

A sample was colected here for analysis from Nos. 3 and 5, the results of which as reported by Messrs. Hite and Krak are given in the table of coal analyses under No. 82.

The same coal is found with the following structure on the land of Mrs. Nelson Jacobs, one-third mile west of the Jones mine:

	Ft.	In.
Slate, black, sandy	5	0
Cannel slate	0	5
Coal .....2′ 0¾″		
Slate, gray.....0 2	3	1¾
Coal 1 0		
Slate and concealed		..

(Elevation of coal, 1400′ A. T., Aneroid.)

The Upper Kittanning coal is mined for farm use, on a run tributary to Whiteday creek, 1.2 miles northwest of Halleck, where Reger obtained the following section:

	Ft.	In.
Shale, gray	3	0
Slate, black	0	6
Coal .....2′ 0″		
Slate, gray.....0 2	3	0
Coal 0 10		

(Elevation, 1510′ A.T., Aneroid.)

The coal is mined along the public road, 1.2 miles northeast of Halleck, where it shows the following section:

	Ft.	In.
Coal .....2′ 9″		
Slate, gray 0 2	3	8
Coal 0 9		
Fire clay	1	0

(Elevation of coal, 1920′ A. T., Aneroid.)

The upper Kittanning coal is mined on the land of Nancy

Martin, on Laurel run, 1.5 miles S. 70° W. of Gladesville, where it has the following section:

	Ft.	In.
Concealed	..	..
Coal blossom	0	0
Shale	4	0
Cannel slate	0	4
Coal 1′ 7½″		
Slate, gray 0 1	2	5½
Coal 0 9		
Shale	..	..

(Elevation of coal, 1745′ A. T., Aneroid).

In **Marion county** the oil well logs do not record Upper Kittanning coal. In Winfield district the coal was once opened on Piney run, 1.2 miles southeast of Canton, where Reger obtained the following section:

	Ft.	In.
Shale, gray, silicious, laminated	3	0
Coal, good 0′ 2″		
Coal, slaty 0 3		
Shale, gray 3 0		
Sandstone 1″ to 0 8	8	1
Slate, black 2 0		
Coal, partly concealed 2 10		

(Elevation, 1055′ A. T., Aneroid.)

Three-fourths mile northwest of Neel, the Upper Kittanning coal is mined and the following section was obtained:

	Ft.	In.
Slate, black, roof		
Coal, good 1′ 0″		
Coal, bony and slaty 0 4		
Coal, good 1 11	4	3
Slate, black 0 1		
Coal, good 0 11		
Slate, pavement	..	..

(Elevation, 1380′ A. T., Aneroid.)

A prospect opening in the Upper Kittanning on the head of Dunham Lick run, 1.2 miles west of Neel, shows the following section:

	Ft.	In.
Concealed	..	..
Coal, good 2′ 6 ″		
Slate, black 0 0¼	3	3¼
Coal, good 0 9		

(Elevation, 1375′ A. T., Aneroid.)

Another opening, evidently the Upper Kittanning coal, was examined by Reger opposite the mouth of Mudlick run, where the following section was obtained:

	Ft.	In.
Shale, gray	5	0
Coal, soft ....0′ 9″		
Slate, black, cannelly..0 5	2	6
Coal 1 4		
Concealed by water,	..	..

(Elevation, 1288′ A. T., Hand Level).

The Upper Kittanning coal was opened once on the land of Jacob Rogers in Union district on Prickett creek, one mile southward from Dunham Lick run, but the mine had fallen shut and its thickness could not be obtained.

A good exposure of the Upper Kittanning coal appears on Whiteday creek near the Moran Schoolhouse, where it has the following section on the land of R. Q. Musgrove:

	Ft.	In.
Sandstone, massive	..	..
Concealed	5	0
Coal, bony, left up....0′ 7″		
Coal, soft 2 0		
Slate, black....0 1	5	2
Coal, soft 1 3		
Slate, gray 0 6		
Coal 0 9		
Fire clay		

(Elevation, 1610′ A. T., Aneroid.)

The Upper Kittanning coal is opened on the head of Grassy run about one-fifth mile east of the crossroads at Gath, where Reger obtained the following section:

	Ft.	In.
Sandstone, gray pebbly	25	0
Coal ....0′ 8″		
Slate 1 0	2	2
Coal 0 6		
Shale, gray	4	0

(Elevation of coal, 1230′ A. T., Aneroid).

In **Taylor county,** the Upper Kittanning coal is mined along the Tygart Valley river, where it is locally known as the "Four-Foot" seam. Three-fourths mile southeast of Valley Falls the following section was obtained south of the river on the land of C. N. Mason:

C. N. Mason Mine, Upper Kittanning Coal. No. 85 on Map II.

		Ft.	In.
1.	Slate	..	..
2.	Coal, soft .....3′ 2 ″		
3.	Slate, gray 0 1	3	8½
4.	Coal, soft 0 5½		
5.	Fire clay	..	..

(Elevation, 1095′ A. T., Aneroid).

The composition, calorific value and fuel ratio of the sample from Nos. 2 and 4 of section are given in the table of coal analyses under No. 85.

The coal was formerly mined on Tucker run, about 1 mile south of Valley Falls, where it was reported by Mr. C. B. Kinsey to be 4 feet thick. A partial section was obtained as follows:

	Ft.	In.
Sandstone, massive, visible	10	0
Slate, sandy	1	0
Coal, blocky	2	0
Concealed by water	..	..

(Elevation, 1070′ A. T., Aneroid).

The coal is mined on a commercial scale by the Winona Coal & Coke Company at Coffman Station in Fetterman district. This mine will be described later in Chapter XII.

It was formerly mined near Coffman Station by the Bessemer Coke Company, where the following section was obtained:

	Ft.	In.
Sandstone, massive	10	0
Shale, with flaggy sandstone	5	0
Coal .....0′ 11 ″		
Bone 0 0½		
Coal 1 9	3	7½
Slate 0 1		
Coal 0 10		

(Elevation, 1013′ A. T., Hand Level.)

The Upper Kittanning coal appears in many of the records of oil wells drilled near the common corner to Booths Creek, Flemington and Courthouse districts. Its occurrence in this region will be described in Chapter XII.

In the central part of Taylor county in the Grafton re-

gion the horizon of the Upper Kittanning coal is entirely under drainage. Inasmuch as no drilling records could be obtained there, its presence is an open question. The A. J. Bartlett core test, No. 719 on Map II, at Webster shows a thickness of 4.8 feet, and the E. H. Bennett core test No. 2 —No. 724 on Map II—at Stonehouse records 2 feet of coal.

The coal appears above drainage along the Tygart Valley river near the Barbour county line. A section measured at an exposure on the Arthur Male farm 1 mile southwest of Cecil, shows the following:

	Ft.	In.
Sandstone, massive, Lower Freeport	40	0
Coal, hard, blocky.....0′ 10″	1	10
Coal, soft.....1 0		
Fire clay, medium	2	9
Cannel slate .....0′ 6″		
Coal 2 9	4	5
Slate 0 1		
Coal 1 1		
Fire clay	..	..

(Elevation, 1050′ A. T., Aneroid.)

Here the lower portion shows the type section of the Upper Kittanning coal, while the upper represents a rider that sometimes appears and that has caused the coal in the Valley Falls region to be called the "Dirty Nine-foot."

The Upper Kitanning coal is exposed in the river hill along the B. & O. Railroad, one-third mile west of Cecil, but only a partial section was visible. On the south side of the river a prospect opening in the hill west of the Overholt Coal & Coke Company plant shows the following:

	Ft.	In.
Sandstone, massive, visible, Lower Freeport	12	0
Coal, medium hard ...0′ 7″		
Coal, soft 0 8		
Slate 1 7	5	2
Coal 2 4		
Concealed by water	..	..

(Elevation, 1080′ A. T., Hand Level.)

The Upper Kittanning coal appears in the northeastern part of Taylor county near the common corner to Monongalia, Marion and Taylor. A coal mine on the head of Maple run, in the edge of Marion county, examined by Reger, shows the following section:

			Ft.	In.
Slate, black	1′	0″		
Coal, slaty	0	8	1	8
Shale, gray			2	6
Slate, black	0′	5″		
Coal, good	1	9		
Slate, gray	0	2	2	10
Coal	0	6		

(Elevation, 1875′ A. T., Aneroid.)

Here the coal carries the same rider that is found along the Tygart Valley river.

The Upper Kittanning coal is mined on Whiteday creek, 1.3 miles northeast of McConkey Schoolhouse, where it has the following section:

W. A. Carrothers Mine, Upper Kittanning Coal. No. 83 on Map II.

				Ft.	In.
1.	Sandstone, massive			..	..
2.	Shale, sandy, gray			5	0
3.	Slate, black			1	0
4.	Coal, hard	1′	0″		
5.	Slate, black	1	0		
6.	Sandstone, dark, hard	0	2		
7.	Shale, gray, soft	1	0		
8.	Coal, bony	0	10		
9.	Coal	1	7	8	1
10.	Slate, gray 0½″ to	0	1		
11	Coal	1	3		
12.	Shale, gray	1	8		
13.	Coal	0	6		

(Elevation, 1528′ A. T., Hand Level.)

Here Reger collected a sample for analysis from Nos. 9, 11 and 13 of section, the results of which, as reported by Messrs. Hite and Krak, are given in the table of coal analyses under No. 83 (Lab. No. 603H).

The Upper Kittanning coal is mined on the head of Whiteday creek, 2 miles northeast of McConkey schoolhouse where Reger measured the following section:

			Ft.	In.
Shale, gray			..	..
Slate, black			0	6
Coal	1′	9″		
Slate, gray	0	1		
Coal	1	4	4	3
Slate, gray	0	7		
Coal	0	6		

(Elevation, 1610′ A. T., Aneroid.)

The coal is mined along the county road 1.6 miles N. 75° W. of Irondale, where Reger reports the following section:

			Ft.	In.
Slate, visible			1	0
Coal	1′	3″		
Slate, gray	0	2		
Coal	1	6	3	11
Slate	0	5		
Coal	0	7		

(Elevation, 1415′ A. T., Hand Level.)

It will be seen from the foregoing sections that the Upper Kittanning coal has a wide distribution and is an important mineral resource of the three counties.

The Upper Kittanning Fire Clay.

At the Monongalia-Preston county line, one mile northwest of Cascade, an excellent flint fire clay makes its appearance immediately under the Upper Kittanning coal. Here Reger made the following section at the prospect mine of Knowlton and Ford:

		Ft.	In.
1.	Slate, black, hard, Upper Kittanning coal	3	0
2.	Fire clay, plastic	2	0
3.	Fire clay flint, Upper Kittanning	9	0
4.	Sandstone, hard 10″ to	1	0
5.	Fire clay, flint, Hardman	2	0
6.	Sandstone, hard	0	4
7.	Fire clay, dark gray, plastic	14	0

(Elevation of coal, 1980′ A. T., Aneroid.)

The large body of flint fire clay that appears in No. 3 of section has not been previously noted in the detailed county reports and will therefore be called the **Upper Kittanning Fire Clay.**

Samples collected from Nos. 3, 5 and 7 showed the following analyses according to Messrs. Hite and Krak:

	No. 3	No. 5	No. 7
Silica ($Si O_2$)	57.78	41.00	56.56
Ferric Iron ($Fe_2 O_3$)	1.24	1.88	2.35
Alumina ($Al_2 O_3$)	28.60	38.28	27.21
Lime (Ca O)	0.37	1.88	0.37
Magnesia (Mg O)	0.17	0.35	0.26
Sodium ($Na_2 O$)	0.34	0.31	0.49
Potassium ($K_2 O$)	0.31	0.14	1.76
Titanium ($Ti O_2$)	0.29	0.28	0.30
Phosphoric Acid ($P_2 O_5$)	0.10	0.50	0.07
Moisture	0.86	1.85	0.93
Loss on ignition	10.85	13.08	9.45
Total	100.91	99.55	99.75

It is possible that the hard lens of sandstone, No. 4 of section, is a replacement of the Johnstown Cement Limestone, although a chemical test gave no carbonate reaction. If this is true, the fire clay noted under No. 5 of section would represent the Hardman fire clay, which is now mined at Hardman in Preston county and which will be described fully in the detailed report of that county, soon to be published.

The Johnstown Cement Limestone.

The next horizon of the Allegheny series is the **Johnstown Cement Limestone** which Mr. Franklin Platt named from its occurrence in Cambria county, Pennsylvania. It is usually found, if present at all, a few feet under the Upper Kittanning coal.

In **Monongalia county** this limestone makes its appearance on a branch of Booths creek, one mile northeast of Clinton Furnace, where Reger obtained the following section:

	Feet.
Coal, thickness concealed, Upper Freeport	0
Shales, ferriferous	15
Concealed	95
Coal blossom, Upper Kittanning	0
Concealed	4
Limestone, hard, Johnstown Cement	6

The linestone has been quarried for local agricultural use. A sample collected for analysis—Laboratory No. 654H—gave the following results, according to Messrs. Hite and Krak:

Clark Haigh Quarry, Johnstown Cement Limestone.

	Feet.
Silicia ($Si O_2$)	2.88
Ferric Iron (Fe_2O_3)	4.13
Alumina (Al_2O_3)	0.74
Calcium Carbonate ($Ca CO_3$)	42.84
Magnesium Carbonate ($Mg CO_3$)	11.03
Phosphoric Acid (P_2O_5)	0.10
Loss on ignition and undetermined	38.28
Total	100.00

The Johnstown cement limestone is present in good

thickness at the road fork on Whiteday creek, one mile north of Anita, where it shows the following section:

	Ft.	In.
Sandstone, massive	10	0
Shale, gray	4	0
Coal, soft, Upper Kittanning	0	6
Fire clay	1	6
Limestone, gray, hard, Johnstown cement	4	0

(Elevation of coal, 1015′ A. T., Aneroid.)

A sample collected for analysis here—Laboratory No. 594H—yielded the following results, according to Messrs. Hite and Krak:

	Per cent.
Silicia ($Si O_2$)	3.42
Ferric Iron (Fe_2O_3)	1.54
Alumina (Al_2O_3)	0.75
Calcium Carbonate ($Ca CO_3$)	90.89
Magnesium Carbonate ($Mg CO_3$)	2.24
Phosphoric Acid (P_2O_5)	0.63
Loss on ignition	0.46
Total	99.93

In **Marion county** the Johnstown Cement Limestone was noted on Piney run of Prickett creek, one mile southeast of Canton, where Reger made the following section:

		Ft.	In.
Sandstone		..	..
Shale, gray silicious		7	0
Coal	0′ 4″		
Shale, gray	3 0		
Sandstone	0 4		
Shale, gray	2 0		
Slate, black	0 6		
Coal	1 8	16	11
Slate, gray	0 1		
Coal	0 6		
Shale, gray, silicious	8 0		
Coal	0 6		
Shale, gray		1	0
Limestone, Johnstown cement		1	0
Shaly, gray, limy, to run		5	0

(Elevation of coal, 1060′ A. T., Aneroid.)

Stratigraphic studies in this vicinity show that the coal noted above is the Upper Kittanning, although it does not resemble the type section. The Johnstown limestone here is too thin to be valuable.

This limestone is quarried for local agricultural use on Grassy run of Prickett creek, one-half mile east of Gath, where Reger made the following section:

		Ft.	In.
1.	Sandstone, massive, making cliff	20	0
2.	Concealed	60	0
3.	Sandstone, flaggy	9	0
4.	Coal, good, no partings, Upper Kittanning	1	4
5.	Concealed	10	0
6.	Sandstone, concealed and sandstone	10	0
7.	Limestone, good, Johnstown Cement	2	0
8.	Concealed	18	0
9.	Coal, Lower Kittanning	..	..

(Elevation of limestone, 1178' A. T., Aneroid).

A sample collected here for annalysis—Laboratory No. 623H—from No. 7 of section gave the following results according to Messrs. Hite and Krak:

	Per cent.
Silicia ($Si O_2$)	9.19
Ferric Iron (Fe_2O_3)	2.20
Alumina (Al_2O_3)	1.73
Calcium Carbonate ($Ca CO_3$)	76.51
Magnesium Carbonate ($Mg CO_3$)	5.92
Phosphoric Acid (P_2O_5)	0.36
Loss on ignition	3.97
Total	99.88

The limestone is exposed in the measures in the eastern part of Taylor county. One-third mile west of Cecil it is 2.5 feet thick, gray on fresh fracture, but weathers to yellow. Its relation to the other strata may be seen by reference to the Cecil section published on a previous page.

The Hardman Fire Clay.

Immediately under the Johnstown Cement limestone an excellent flint fire clay makes its appearance and is mined commercially one mile north of Hardman, Preston county, near the Taylor county line. It will be described in detail in the report on Preston County soon to be published.

The Hardman fire clay is also visible at Irontown, in the hill north of the B. & O. Railroad, where, according to Reger, it is 9 feet thick, hard and flinty, coming 1152 feet above tide.

It has been prospected into the hill a sufficient distance to show that it is a valuable deposit.

The Middle Kittanning Coal.

The Middle Kittanning coal, which sometimes appears in the Allegheny series between the Upper and Lower Kittanning, was noted with certainty at only one place in the territory of this report, viz., in the Bennett No. 2 bore hole, No. 124 on Map II, at Stonehouse, Taylor county, where it is 1 foot thick and 29 feet under the Upper Kittanning coal. The bore hole record is published on a previous page.

The Lower Kittanning Coal.

The **Lower Kittanning coal**, which was named by Prof. Lesley from its occurrence in Armstrong county, Pennsylvania, is of great economic importance in the territory of this report. The section of the coal varies greatly throughout the area and for this reason a type formation cannot be given. It will usually be found, however, that the Lower Kittanning coal carries, near the middle of the seam, a heavy streak of bony coal or shale, the thickness of which runs from a few inches to one foot. This heavy impurity serves in a large measure to distinguish the coal from the Upper Kittanning bed above and the Clarion coal below, neither of which has such a marked feature.

The crop of the Lower Kittanning coal is shown in detail on Map II by an appropriate symbol. In Monongalia county the crop is roughly parallel to the Monongahela river and the Chestnut Ridge anticline, between which it appears.

In **Marion county** the crop of the Lower Kittanning coal is limited to the eastern portions of Winfield and Union districts.

In **Taylor county** there is a small region of crop in Booths Creek district along the Tygart Valley river. In the eastern part of the county it crops on the waters of Whiteday, Threefork and Sandy creeks and on the Tygart Valley river.

The stratigraphic relations and the thickness of the Lower

Kittanning coal may be found in great detail by reference to the geologic sections for Clinton Furnace, Triune, Anita, Montana Mines, Powell, Webster, Irondale and Cecil.

By reference to the "List of Wells Recording Lower Kittanning Coal", published on a subsequent page, it will be seen that, with the exception of a small deposit in Cass district, Monongalia county, no Lower Kittanning coal has been found west of the Monongahela river. East of the river in Monongalia and Marion counties there has not been sufficient drilling to outline with certainty the extent of the coal where it lies under drainage. In Taylor county several wells drilled at Pruntytown, Meadland, Webster and Stonehouse indicate that a large amount of the coal lies buried beneath the overlying strata of that county.

In **Monongalia county,** no Lower Kittanning coal of sufficient importance to deserve mention was found along the crop north of the Morgan-Clinton district line. At Clinton Furnace on Booths creek, the coal is 3 feet thick as recorded in the section. One-third mile south of Clinton Furnace, Reger examined an exposure of this bed in the hill east of Booths creek as follows:

	Ft.	In.
Sandstone, massive	..	..
Coal, good	3	0
Shale, gray	0	5
Concealed	..	..

(Elevation of coal, 1100' A. T., Aneroid.)

At the residence of Granville Brown, 1.3 miles north of Halleck, this coal has been mined and has the following section:

	Ft.	In.
Shale, gray	2	0
Slate, gray and black	1	0
Coal, bony 1′ 6″		
Slate, black 0 3	2	5
Coal, soft 0 8		
Slate		..

(Elevation, 1790' A. T., Aneroid.)

The Lower Kittanning coal is mined extensively for domestic use on the land of Joseph Repport, where Reger reports the following section:

Joseph Repport Mine, Lower Kittanning Coal. No. 87 on Map II.

		Ft.	In.
1.	Shale, dark	3	0
2.	Coal ..... 0′ 2″		
3.	Slate, black 0 3		
4.	Shale, gray..... 2 6	6	1
5.	Coal 2 0		
6.	Slate 0 2		
7.	Coal 1 0		

(Elevation, 1790′ A. T., Aneroid.)

A sample collected for analysis from Nos. 5 and 7 is reported by Messrs. Hite and Krak in the table of coal analyses under No. 87 (Lab. No. 626-H).

The coal is mined one-fourth mile east of Halleck, where it has the following section:

Lower Kittanning Coal. No. 88 on Map II.

		Ft.	In.
1.	Concealed	..	..
2.	Sandstone, dark, hard	0	2
3.	Slate, black	0	5
4.	Cannel slate..... 0′ 3″		
5.	Coal, soft..... 2 0	3	3
6.	Slate, gray..... 0 1		
7.	Coal, soft 0 11		
8.	Slate	..	..

(Elevation, 1825′ A. T., Aneroid.)

A sample was collected for analysis from Nos. 5 and 7 and as reported by Messrs. Hite and Krak is given in the table of coal analyses under No. 88 (Lab. No. 579-H). This sample evidently contained a lens of sulphur as the analysis shows a much larger amount of this impurity than the Repport mine, a short distance away.

This bed is mined 1.2 miles south of Halleck on the land of Wm. Phillips, where Reger secured the following section:

	Ft.	In.
Coal ..... 0′ 5″		
Shale, gray 2 3		
Slate, black 0 4		
Coal 1 11		
Slate, gray..... 0 2	6	9
Coal 1 2		
Slate, gray 0 2		
Coal, hard 0 4		

(Elevation, 1750′ A. T., Aneroid.)

The Lower Kittanning is mined on the land of Mary L. Rogers at the schoolhouse ¼ mile east of the Phillips mine, where it shows the following section:

			Ft.	In.
Slate, roof			..	..
Cannel slate	0′	4½″		
Coal	2	0	3	5½
Slate, gray	0	1		
Coal, 11″ to	1	0		
Slate, gray			0	3
Concealed			40	0
Sandstone, massive, making cliff			..	..

(Elevation, 1430′ A. T., Aneroid.)

The coal is mined 2.2 miles southeast of Halleck, on Laurel run, where it has the following section:

			Ft.	In.
Sandstone, massive, Lower Freeport			10	0
Coal	0′	7 ″		
Slate, gray	0	0½		
Coal	0	8		
Slate, gray	0	7	3	6½
Coal	0	7		
Slate, black	0	3		
Coal, bony	0	4		
Coal, soft	0	6		
Slate and concealed			15	0
Sandstone, massive, white			..	..

(Elevation of coal, 1685 A. T., Aneroid.)

The Lower Kittanning coal is mined 2 miles northwest of Gladesville, where Reger measured the following section:

Samuel Frederick Mine, Lower Kittanning Coal. No. 89 on Map II.

				Ft.	In.
1. Slate				..	..
2. Coal	1′	0″			
3. Shale, gray	0	4			
4. Coal, good	2.	6		5	1
5. Slate	0	4			
6. Coal, good	0	11			
7. Slate				..	..

(Elevation, 1895′ A. T., Aneroid).

A sample collected from Nos. 2, 4 and 6 is published, as reported by Messrs. Hite and Krak, in the table of coal analyses under No. 89 (Lab. No. 651-H).

The coal was formerly mined along the Morgantown and Beverley pike at the road fork, ¼ mile from the Preston county line. The mine is now abandoned, but, according to Reger, the mining section was about 5 feet.

The Lower Kittanning coal is mined along the same pike a short distance from the Preston line, where Reger measured the following section:

		Ft.	In.
1.	Shale, gray	..	..
2.	Coal, good 0′ 11″		
3.	Shale, gray 0 3	3	6
4.	Coal, good 2 4		
5.	Shale, gray and concealed	30	0
6.	Fire clay	5	0
7.	Concealed	13	0
8.	Slate, black	2	0
9.	Fire clay, gray	19	0
10.	Slate, black	1	0
11.	Sandstone, white, soft, Homewood	20	0

(Elevation of coal, 1875′ A. T., Aneroid.)

The intervals and thicknesses of the lower portion of this section are uncertain as the rapid dip of the measures prevented accurate measurement.

This coal is mined on the land of Wm. Morris on Whiteday creek, ¾ mile northwest of Anita, and has there the following section, according to Reger:

		Ft.	In.
1.	Sandstone	..	..
2.	Shale, sandy	4	0
3.	Slate, black	0	5
4.	Slate, cannel 0′ 4″		
5.	Coal, good 1 2		
6.	Coal, bony 0 10	5	5
7.	Coal 1 2		
8.	Bone 0 1		
9.	Coal, good, soft 1 10		
10.	Slate	..	..

(Elevation, 1035′ A. T., Aneroid.)

In **Marion county** the Lower Kittanning coal shows a good thickness at almost all points where its horizon appears above drainage. On lick run, one-eighth mile from Anita, Reger made the following section at a prospect opening:

	Ft.	In.
Sandstone	3	0
Shale, brown	4	0
Slate, black	1	0
Coal ..... 2′ 6″		
Slate 0 1	4	5
Coal 1 10		
Shale, gray	1	0
Concealed	10	0
Sandstone	5	0
Concealed to Lick Run	5	0

(Elevation of coal, 1075′ A. T., Aneroid.)

On Lick run, one-half mile east of Forksburg, the Lower Kittanning coal is found in good thickness. The following section was measured there by Reger:

Marcellus Jolliffe Mine, Lower Kittanning Coal. No. 90 on Map II.

		Ft.	In.
1.	Shale, brown	5	0
2.	Slate, black, cannel	0	8
3.	Coal ..... 2′ 1″		
4.	Slate 0 1	5	2
5.	Coal 3 0		

(Elevation. 1150′ A. T., Aneroid.)

A sample was collected from Nos. 3 and 5 and its composition, etc., as reported by Messrs. Hite and Krak are given under No. 90 (Lab. No. 625-H) in the table of coal analyses.

The section of the coal at this mine bears some resemblance to the Upper Kittanning coal, since it has cannel slate at the top and carries only one slate parting, but the lowest member is much thicker than the lower bench of the Upper Kittanning. Aside from this important difference the coal was traced down Lick run to the Morris mine at Anita where the usual ten-inch streak of bony coal appears in the middle of the seam.

The Lower Kittanning was formerly mined at the road fork on Lick run, ½ mile southeast of Forksburg, but the mine had fallen shut and the section was mostly concealed.

This coal is mined extensively for local domestic use on the head of Prickett creek, one-fourth mile southeast of Samaria, where Reger secured the following section:

		Ft.	In.
Sandstone, shaly		5	0
Slate, black		1	0
Coal, good	2′ 0″		
Slate	0 1		
Coal	0 10		
Coal, cannel	0 7	4	10
Coal, good	1 10		
Slate, black	0 1		
Coal	0 3		

(Elevation, 1230′ A. T., Aneroid.)

On Long run, one mile south of Samaria, the following section of this bed was obtained by Reger on the land of Jack Vincent:

		Ft.	In.
Cannel slate		0	8
Coal	1′ 9″		
Slate	0 1		
Coal	0 10	4	2
Cannel coal	0 6		
Coal	1 0		

(Elevation, 1260′ A. T., Aneroid.)

On Prickett creek, 1.3 miles northwest of Hebron church, the Lower Kittanning coal has the following structure as measured by Reger:

		Ft.	In.
Shales, gray, silicious, finely bedded		10	0
Cannel slate		0	5
Coal, soft	1′ 10″		
Slate	0 2		
Coal, soft	0 10		
Slate, with numerous plant fossils	0 2	4	4
Coal, blocky	1 4		
Concealed		..	..

(Elevation, 1240′ A. T., Aneroid.)

On the head of Prickett creek, along the Winfield-Union district line, 1.8 miles southwest of Neel, Reger measured the following section of the coal on the land of Jacob Rogers:

		Ft.	In.
Sandstone, massive, steel gray, Lower Freeport		20	0
Slate, gray		0	3
Coal, slaty	0′ 10″		
Slate	0 1		
Coal	2 1	4	11
Slate	0 1		
Coal	1 10		

(Elevation, 1280′ A. T., Aneroid.)

On Dunham Lick run of Prickett creek the Lower Kittanning carries about three feet of **cannel coal** in its lower portion. A section of the coal measured by Reger on the land of Jacob Rogers, 1.6 miles northwest of Neel, shows the following structure:

Jacob Rogers Mine, Lower Kittanning Coal. No. 92 on Map II.

		Ft.	In.
1.	Sandstone, shaly	10	0
2.	Shale, gray	4	0
3.	Coal, cannel, slaty.0′ 7″		
4.	Coal, soft.....2 8	5	5
5.	Slate, gray.....0 2		
6.	Coal, cannel 2. 0		
7.	Concealed by water	..	..

(Elevation, 1245′ A. T., Aneroid.)

The composition of the sample collected from No. 6 of section, as reported by Messrs. Hite and Krak, is given under No. 92 (Lab. No. 610-H) in the table of coal analyses. The sample, which was collected by Reger, was taken from a freshly cleaned face of an old working abandoned many years ago. The coal is excessively high in ash and does not show the unusual amount of volatile matter which its appearance indicated. There was no physical evidence of oxidation, but it is possible that if a new working face had been available the coal would have shown a higher volatile content.

According to Jacob Rogers this coal was mined extensively before the Civil War and hauled by mules over a tram road to Hammond station on the Baltimore & Ohio Railroad, where it was shipped away and used for distilling oil and gas. The upper part of the coal was regarded as worthless and thrown on the dump where it was allowed to waste. The discovery of petroleum, about the time of the Civil War, caused the mine to be abandoned.

The same coal is mined at another opening on the land of Jacob Rogers, 1.2 miles east of Neel, where it has the following structure:

Jacob Rogers Mine, Lower Kittanning Coal.
No. 93 on Map II.

		Ft.	In.
1.	Sandstone	5	0
2.	Shale, sandy	7	0
3.	Shale, dark	0	6
4.	Cannel slate	0	4
5.	Coal, soft .....3′ 0 ″		
6.	Slate, black 0 1½	6	1½
7.	Cannel coal 3 0		
8.	Black slate	4	0
9.	Fire clay, good	5	0
10.	Sandstone, gray and massive to run 5		0

(Elevation of coal, 1255′ A. T.-Aneroid.)

The composition, calorific value and fuel ratio of the sample collected here by Reger from No. 5 are given under No. 93 (Lab. No. 627-H) and one collected from No. 7 under No. 93 (Lab. 628-H) in the table of coal analyses.

The extent of this cannel formation in the Lower Kittanning coal is uncertain. Northwest of Dunham Lick run, at Samaria, there is only 7 inches of cannel coal and west of Dunham Lick, on Long run, there is only 6 inches. South of Dunham Lick the two exposures examined on Prickett creek do not show cannel coal at all. About two miles east of mine No. 93 on Dunham Lick run, there is an old mine in Taylor county on Whiteday creek, ½ mile from the Marion county line that is reported to have produced cannel coal. This mine has been abandoned for many years so that a section could not be obtained. It is possible that a considerable body of cannel coal may be found beneath the hills east of Dunham Lick run.

The Lower Kittanning coal is mined on Grassy run, one-half mile east of Gath where Reger secured the following section:

Owen Vincent Mine, Lower Kittanning Coal.
No. 91 on Map II.

		Ft.	In.
1.	Cannel slate	0	7
2.	Coal, good .....2′ 0″		
3.	Slate 0 1	4	9
4.	Coal, good 2 8		

(Elevation, 1160′ A. T., Aneroid.)

The composition, etc., of the sample collected from Nos 2 and 4, as reported by Messrs. Hite and Krak, are given under No. 91 (Lab. No. 624-H) in the table of coal analyses.

This bed is mined on Grassy run, 1 mile east of Gath, where Reger made the following section, hand level measurement, that includes it:

			Ft.	In.
Shale, brown			6	0
Slate, black, cannelly			0	7
Coal, slaty	2′ 9″			
Coal, cannel	0 4			
Slate	0 1	Lower Kittanning	4	11
Coal	1 6			
Slate	0 1			
Coal	0 2			
Shale, gray and concealed			27	0
Coal, Clarion, visible			0	6
Fire clay, gray, with iron ore nuggets			19	0
Sandstone, massive, to run, Homewood			28	0

(Elevation of Lower Kittanning coal, 1180′ A. T., Aneroid).

The Lower Kittanning coal has been prospected extensively along the Tygart Valley river near the Marion-Taylor county line, where the Chestnut Ridge Anticline brings it above drainage. One-fourth mile east of Powell the coal has the following section in the river hill:

		Ft.	In.
Sandstone, massive, Lower Freeport, visible		25	0
Shale, sandy, 12″ to		0	0
Cannel slate		0	6
Coal	2′ 0″		
Slate, black	0 0½		
Coal	0 7		
Slate	0 0½	5	0½
Coal	0 10		
Slate, ½″ to	0 1		
Coal, softer	1 5½		
Fire clay, visible		1	6

(Elevation of coal, 995′ A.T., Aneroid).

In **Taylor county** the Lower Kittanning coal is exposed along the Tygart Valley river at several points. It was once mined on Meetinghouse run, ½ mile southeast of Powell, but the mine had fallen shut and could not be measured.

This coal was once mined on the land of C. N. Mason, ¾ mile southeast of Valley Falls, but the mine had fallen shut and its section could not be obtained. The coal is locally

known as the "Five-Foot" seam to distinguish it from the Upper Kittanning which is called the "Four-Foot".

The Lower Kittanning coal is mined on a commercial scale by the Winona Coal & Coke Company at Coffman Station. This mine will be described in detail in Chapter XII.

In the southern part of Taylor county this coal appears above drainage and is mined commercially at Cecil. Its character will be discussed in Chapter XII.

An exposure measured at the Barbour county line, ¾ mile southeast of Cecil, on the land of Granville Male shows the following section:

	Ft.	In.
Sandstone, massive, Lower Freeport, visible	5	0
Shale, sandy	3	0
Slate, black	2	0
Coal, soft 2′ 7″		
Coal, bony 0 7	5	5
Coal, soft 2 3		
Fire clay and concealed	20	0
Sandstone, massive, pebbly, white, Homewood	40	0

(Elevation of coal, 1145′ A. T., Aneroid).

This coal is mined on the south side of Sandy creek, in Barbour county, ¾ mile southwest of Hiram, where it has the following section:

Harvey Phillips Mine, Lower Kittanning Coal. No. 96 on Map II.

		Ft.	In.
1.	Sandstone, massive, coarse and pebbly, with fossil plants, Lower Freeport	40	0
2.	Fire clay 2′ to	3	0
3.	Coal 0′ 5″		
4.	Slate, black 0 2		
5.	Coal, soft 1 3		
6.	Slate, 0½″ to 0 1	5	7
7.	Coal 1 1		
8.	Slate, gray, 2″ to 0 4		
9.	Coal, bony 0 5		
10.	Coal, good 1 10		
11.	Slate		

(Elevation, 1220′ A.T., Aneroid).

The composition, etc., of the samples collected from Nos.

5, 7 and 10 of the section are given under No. 96 (Lab. No. 575-H) in the table of coal analyses.

In northeastern Taylor county the Lower Kittanning is mined on Laurel run, 1 mile northwest of Irondale. A section measured here shows the following structure:

Chas. Sapp Mine, Lower Kittanning Coal.—No. 94 on Map II.

		Ft.	In.			
1.	Coal, slaty	0	8			
2.	Shale, gray	2	0			
3.	Coal, 8" to	0	11			
4.	Slate, gray, hard	0	5			
5.	Coal, bony	0	7		8′	9″
6.	Slate, black	0	11			
7.	Coal, soft	2	3			
8.	Slate, black	0	6			
9.	Coal, bony	0	6			
10.	Fire clay					

(Elevation, 1355′ A. T., Hand Level).

Nos. 8, 9 and 10 were concealed, but they were furnished by Charles Sapp. Reger collected a sample from No. 7 the composition of which, as reported by Messrs. Hite and Krak is given under No. 94 (Lab. No. 602-H) in the table of coal analyses.

This seam is mined for domestic use one-half mile northwest of Hardman Station, where Reger measured the following section:

	Ft.	In.
Sandstone	20	0
Shale, gray	5	0
Limestone, gray, thickness concealed	0	0
Concealed and shale	33	0
Sandstone, shaly	15	0
Concealed	20	0
Slate, black	1	0
Coal 0′ 11″		
Slate 0 2		
Coal 1 9	2	11¼
Slate 0 0¼		
Coal 0 1		

(Elevation of coal, 1123′ A. T., Hand Level).

A further discussion of the Lower Kittanning coal, with estimates of its probable tonnage, will be given in the chapter on Coal.

The Lower Kittanning Fire Clay.

Immediately under the Lower Kittanning coal there is a fire clay that has a wide distribution in Western Pennsylvania and Ohio. It is also mined extensively in Hancock county, West Virginia, where it is used for building brick and paving blocks. This clay has a good exposure in Union district, Monongalia county, ½ mile southeast of Laurel Iron Works, where the following section was made by hand level:

	Ft.	In.
Slate, gray, visible	1	0
Coal ..... 2 6 " }		
Slate, black ..... 0 0½ } Upper Kittanning	3	1
Coal ..... 0 6½ }		
Fire clay and concealed	23	0
Shale, sandy	5	0
Coal, Lower Kittanning, 6" to	2	0
Slate	1	6
Fire clay, flinty, Lower Kittanning, 3' to	4	0
Concealed	5	0
Limestone	1	0

A sample was collected from the Lower Kittanning fire clay and its analysis is reported as follows by Messrs. Hite and Krak under Lab. No. 638-H:

	Per cent.
Silica ($Si O_2$)	54.02
Ferric Iron (Fe_2O_3)	4.17
Alumina (Al_2O_3)	19.09
Lime (Ca O)	6.10
Magnesia (Mg O)	1.92
Sodium (Na_2O)	0.37
Potassium K_2O)	2.54
Titanium ($Ti O_2$)	0.50
Phosphoric Acid (P_2O_5)	0.76
Moisture	0.37
Loss on ignition	9.74
Total	99.58

The analysis shows such an excess of lime oxide that it is doubtful whether an attempt to use the clay for brick would prove successful.

At Hammond, Marion county, a fire clay occurs in the river hill that apparently correlates with the Lower Kittanning fire clay. It is 5 feet thick and comes 80 feet above the Ham-

mond fire clay that is now being used by the Hammond Fire Brick Company. The Lower Kittanning fire clay was formerly quarried here for brick making, but the quarry was abandoned in 1912.

The Vanport (Ferriferous) Limestone.

In western Pennsylvania and Ohio a limestone occurs below the Lower Kittanning fire clay that carries marine fossils and sometimes has a thickness of 10 to 15 feet. It is usually covered with a thin layer of iron ore that is often mined for furnace use. This limestone was not observed in the territory of this report. The Vanport iron ore was observed one-half mile southeast of Dellslow, Monongalia county, and at the Eureka schoolhouse on Whiteday creek in Marion county near the Monongalia line. Its character will be discussed in Chapter XIII.

The Clarion Sandstone.

The **Clarion sandstone,** which belongs beneath the Ferriferous limestone and is prominent in parts of Pennsylvania and in Garrett county, Maryland, was not observed above drainage in Monongalia, Marion or Taylor counties, but it appears in the sections for Morgantown and Webster.

The Clarion Coal.

The **Clarion coal,** which was named from its occurrence in Pennsylvania, is the lowest bituminous member of the Allegheny series that has been observed in the territory of this report. Its crop may be followed closely on Map II by observing the base of the Allegheny series which is almost identical with the Clarion coal. Its thickness and stratigraphic relation may be seen by reference to the sections for Morgans Run, Beaverhole, Morgantown, Powell, and Irondale.

The Clarion coal has been mined in Preston county on Bee run, 0.5 mile south of Cheat river and 1.3 miles southeast

of Beaverhole. A section measured there shows the following structure:

Zacheus Gibson Mine, Clarion Coal.—No. 99 on Map II.

		Ft.	In.
1.	Sandstone, massive.....		
2.	Coal .....2′ 6″		
3.	Slate, black, ½″ to.0 1		
4.	Coal 1 0	6	7
5.	Slate, gray 0 8		
6.	Coal 2 4		
7.	Fire clay and concealed.....	10	0
8.	Sandstone, massive, Homewood.....		

(Elevation of coal, 1525′ A. T., Aneroid).

The composition, calorific value and fuel ratio of the sample collected from Nos. 2, 4 and 6, as reported by Messrs Hite and Krak are given under No. 99 (Lab. No. 634-H) in the table of coal analyses.

The same coal has been mined at several other localities near the Gibson mine, but its discussion will be given in the report on Preston county.

The Clarion coal was noted at the Morgan-Clinton district line, 1.2 miles northwest of Rohr, where it is 4 to 5 feet thick and slaty. This coal is mined on Laurel run, 2.1 miles southwest of Gladesville, and one-half mile from the Monongalia-Taylor line, where it has the following section:

	Ft.	In.
Slate, gray, hard.....	2	0
Coal .....0′ 6″		
Slate, gray, hard, 0″ to.0 1		
Coal 0 10		
Slate, dark 0 7	5	7
Coal 1 0		
Slate, dark.....0 10		
Coal 1 9		
Slate		

(Elevation, 1530′ A. T., Aneroid).

The Clarion coal is visible along the public road where Laurel run crosses the Monongalia-Taylor line.

This coal has been prospected recently on a branch of Laurel run, Taylor county, 1.2 miles northwest of Irondale, where Reger secured the following section on the J. B. Watson farm:

			Ft.	In.
Sandstone			12	0
Slate			1	4
Coal	1′	7 ″		
Slate	0	0½		
Coal	0	6		
Slate, black	1	0	5	1½
Coal, bony	0	10		
Slate, gray	0	11		
Coal	0	3		
Concealed				

(Elevation, 1336′ A. T., Aneroid).

In **Marion county** no Clarion coal of commercial thickness was found. Its horizon appears in a section published under the description of the Lower Kittanning coal on Grassy run, one mile east of Gath, where it is 6 inches thick.

In **Taylor county,** in addition to the exposure noted above on Laurel run, the Clarion coal is recorded in the Martha Tucker gas well, Map No. 697, 1 mile south of Valley Falls, where it is 7 feet thick.

The Clarion Fire Clay.

In western Pennsylvania and in Hancock county, West Virginia, a bed of fire clay occurs under the Clarion coal that has been named the **Clarion fire clay.** This clay was not observed above drainage at any point, but the record of the Gamble Boring (337), published in the section for Rock Forge, Monongalia county, shows 11.6 feet of fire clay under the Clarion coal. The horizon is usually occupied by sandy shales when the Clarion coal does not rest directly on the Homewood sandstone.

CHAPTER IX.

STRATIGRAPHY—POTTSVILLE SERIES

The Pottsville series, or Pottsville Conglomerate, which lies next under the Allegheny, was named by Prof. J. P. Lesley from its occurrence at Pottsville, Pennsylvania, where it has a striking development, being composed of alternate anthractic coal and sandstone members. The sandstones are mere masses of quartz pebbles, ranging in size from one-eighth to two inches in diameter, cemented together into irregular strata.

In the territory of this report the Pottsville series retains in only a slight degree the features that give it prominence at Pottsville. Here it has lost much of its pebbly character, while the coals are bituminous and usually too thin to be economically important.

An ideal section of the Pottsville series for this part of West Virginia would show the following:

General Section, Pottsville Series in Northern West Virginia.

	Thickness. Feet.	Total. Feet.
Sandstone, massive, gray with occasional quartz pebbles, Homewood	50	50
Coal, Tionesta	1	51
Fire clay, flinty, Mt. Savage	5	56
Fire clay and sandy shales with iron ore	25	81
Coal, streak	0	81
Fire clay and shale	5	86
Coal, streak	0	86
Fire clay, flinty, Hammond	4	90
Coal, Upper Mercer	5	95
Shales, brown, sandy	10	105
Limestone, ferriferous, hard, Lower Mercer	1	106
Coal, Lower Mercer	1	107
Fire clay and shales	1	108
Sandstone, hard, massive, white, with angular quartz pebbles, Upper Connoquenessing	75	183
Coal, Quakertown	2	185

	Thickness. Feet.	Total. Feet.
Shale, sandy	15	200
Sandstone, hard, massive, white, with some pebbles, Lower Connoquenessing	60	260
Coal, Sharon, streak	0	260
Shale, sandy	15	275
Sandstone, massive, pebbly, Sharon	25	300

The pebbles of the Pottsville series in this region are angular and small. The only evidence of transportation is that due to rolling friction, as none of them are flattened or oblong, the only abrasion being at the corners.

No evidence of animal life, either of marine or fresh water origin was observed in these rocks, although a minute investigation of this phase was not made. It may be considered certain, however, that there are not enough fossils in the series to make them easily available in stratigraphic determinations.

The plant life in the Pottsville series is abundant. Lepidodendra and sigillariae, which were not often observed in the rocks above the Pottsville, are present in great numbers and afford the stratigrapher a fairly reliable means of tracing the line between the Allegheny and Pottsville series, their size and peculiar forms making them easy to recognize.

The succession and character of the Pottsville rocks are given in numerous general sections in Chapter IV. Additonal sections of the Pottsville will now be given, affording a more detailed knowledge of these measures.

A section showing the lower sandstone members of the Pottsville series, made by Reger south of Lick Run Station on the M. & K. Railroad in Monongalia county, shows the following:

Lick Run Section, Pottsville Series.

	Thickness. Feet.	Total. Feet.
Sandstone, massive, white, Upper Connoquenessing	75	75
Concealed	20	95
Sandstone, very soft, white, Lower Connoquenessing	40	135
Concealed	40	175
Sandstone, flaggy, gray, hard, white, Sharon	15	190
Concealed to Mauch Chunk reds	35	225
(Elevation of basal member, 1935' B-A. T.)		

The following section, showing the upper portion of the Pottsville, was measured south of the Tygart Valley river at Valley Falls, in Taylor county:

Valley Falls Section.

	Thickness. Feet.	Total. Feet.
Sandstone, massive, Homewood, visible....	20	20
Shale, dark, Tionesta coal horizon.....	5	25
Shale, sandy.....	10	35
Fire clay, hard, laminated, Mt. Savage.....	10	45
Concealed	3	48
Fire clay, hard, laminated.....	10	58
Shale, dark.....	4	62
Coal, hard.....1′ 4″ to	1	63
Sandstone, massive.....	20	83
Coal, bony .....0′ 4″		
Slate, gray.....0 2		
Coal, bony.....0 7 | Upper Mercer		
Slate, gray.....0 2 } Mine No. 101		
Coal, soft.....2 0 | on Map II..	5	88
Slate, gray.....2″ to 0 3		
Coal, blocky.....1 6		
Fire clay, friable.....	6	96
Sandstone, visible.....	1	97
Concealed to Falls sandstone, Upper Connoquenessing	18	115

(Elevation of Upper Mercer coal, 1000′ A. T., Hand Level).

DESCRIPTION OF POTTSVILLE FORMATIONS.

The Homewood Sandstone.

The Homewood sandstone, which is the upper member of the Pottsville series, was named by I. C. White from its outcrop in Beaver county, Pennsylvania, where it reaches the great thickness of 150 feet. In the territory of this report it seldom exceeds 50 feet and is often less than that. It is usually light gray in color and medium hard, but often weathers white on exposure and becomes so soft that it crumbles easily under the blow of a hammer. It has an abundant fossil record of plant life, most of the forms being the coarser ones such as lepidodendra and sigillariae. It sometimes contains quartz pebbles, but this feature is not always found. It often carries water when under drainage and has

produced both oil and gas, being known to the drillers as the "Second Cow Run sand".

The Homewood sandstone crop coincides with that of the base of the Allegheny series which is shown on Map II. In Monongalia county it crops in Union, Morgan and Clinton districts: in Marion it crops only in Winfield and Union; in Taylor its crop is mainly in Booths Creek and Fetterman districts, but it rises above drainage also along the Tygart Valley river at the southeast edge of the county in Knottsville district.

The stratigraphic position and thickness of the Homewood sandstone may be found by reference to the geologic sections for Mont Chateau, Quarry Run, Beaverhole, Morgantown, Sturgisson, Downs, Montana Mines, Powell, Webster, Irondale and Stonehouse.

In **Monongalia county** the Homewood sandstone crops at numerous points along the Chestnut Ridge Anticline, and is a prominent feature near Sand Spring along the Preston county line. On Cheat river it rises above drainage at the island north of Mont Chateau and the eastward rise of the strata carries it into the air two miles east of that point. At Dellslow, on the M. & K. Railroad, the Homewood sandstone appears above drainage near the mouth of Tibbs run and makes prominent cliffs on either side of Deckers creek. On the south side of the creek its outcrop was followed continuously by Reger from Dellslow three miles southeastward to Mack, where it is near the summit of the lofty hills. It passes under drainage at Cascade, Preston county, one mile S E from the Monongalia line. It is a prominent feature along the Beverly pike at the head of Field creek, three miles northwest of Gladesville, where Reger secured the following data on the Hiram Miller farm:

	Ft.
Coal, slaty, thickness concealed, Clarion	0
Sandstone, massive, white, Homewood	25

The sandstone is very soft, medium grained and free from pebbles. A sample collected here under Laboratory No. 653H,

gave the following results, according to Messrs. Hite and Krak:

	Per cent.
Silica ($Si O_2$)	99.02
Ferric Iron (Fe_2O_3)	0.03
Alumina (Al_2O_3)	0.44
Total	99.49

In Marion county the Homewood sandstone appears above drainage on Prickett creek along the Winfield-Union district line. Its outcrop there is not a prominent feature and there is not the usual amount of talus from it in the streams. It crops along the Tygart Valley river between Powell and Coffman station, and is often 40 to 50 feet thick, pebbly, and forms cliffs in that region.

In Taylor county it crops in Booths Creek district opposite the line of outcrop named for Marion county. Near Cecil, on the Tygart Valley river, it rises above drainage one-fourth mile west of the Barbour line, where it is 40 feet thick, white, pebbly and comes 20 feet under the Lower Kittanning coal. Its crop extends up Sandy creek one mile above the mouth of the creek. Northwest of Irondale it crops along Laurel run, where it may be seen at numerous points near drainage.

The Tionesta Coal.

Between the Homewood and Upper Connoquenessing sandstones several coals appear that have been named collectively the **Mercer Group** by Pennsylvania geologists, from their outcrop in Mercer county in that State. In the territory of this report five coal seams were found in this interval, all of which appear in the section for Powell in Chapter IV. This section represents the maximum development, as at other points only one or two coals were usually found.

The first of the Mercer group of coals, which lies immediately under the Homewood sandstone, was named the **Tionesta** by the geologists of the First Geological Survey of Pennsylvania. In Somerset county, Pennsylvania, it was called the **Mt. Savage** coal and the same title was given to it by Dr. Martin in Garrett county, Maryland.

The Tionesta coal has but little scientific, and no commercial importance, in the territory of this report. It appears in the geologic sections published in Chapter IV for Rohr and Powell. It was observed at a few points in Morgan district, Monongalia county, along the Chestnut Ridge Anticline. On the Kingwood pike, 1¼ miles southwest of Mack, it has the following section:

	Ft.	In.
Sandstone, white, massive, pebbly, Homewood...	60	0
Concealed	5	0
Coal, slaty, Tionesta.....	1	3

(Elevation of coal, 1980' A. T., Aneroid).

The Mt. Savage Fire Clay.

Directly beneath the Tionesta coal a flint fire clay often occurs. It was named the Mt. Savage from its outcrop at Savage Mountain, Somerset county, Pennsylvania, where it has been mined extensively. In that locality and in Garrett county, Maryland, it is used, along with the plastic clay that occurs with it, for fire brick and other purposes where a clay with refractory qualities is needed.

In the territory of this report the Mt. Savage fire clay is not generally present, but its outcrop was noted in a few places. In the geologic section for Powell, it is noted immediately under the Tionesta coal where it is 6 feet thick, but of doubtful purity.

In Monongalia county, southeast of Sturgisson, Reger reports it as occurring in a few places immediately over the Upper Mercer coal where it is about 5 feet thick but impure as it contains nuggets of iron ore. Its section there will be given under the discussion of Upper Mercer coal.

It is not probable that the Mt. Savage fire clay will prove to be of much economic importance as the fact that talus from it was seldom seen in the region of its crop indicates that it is not usually present.

The Hammond Fire Clay.

At Hammond, Marion county, a fire clay occurs that has been mined extensively and manufactured into fire brick by

the Hammond Fire Brick Company. By reference to the Powell section it may be seen that this fire clay is separated from the Mt. Savage fire clay by a small seam of coal, a fact that proves conclusively that it is a separate horizon. Since this clay has not been previously named in any official publications, it will be styled the **Hammond Fire Clay.**

The clay worked at this horizon at the mine of the above mentioned company at Hammond has the following section descending:

	Ft.
Flint clay, 2′ to	5
Plastic clay, 6′ to	8

The chemical composition and physical properties of each type of clay, along with a description of the brick plant and mine at this place are given on pages 220-222 of Vol. III of the State Survey reports. Therein the clay has been erroneously assigned to the Lower Kittanning horizon, as will appear from a study of the Powell section, page 145.

The Hammond Fire clay is evidently a replacement of the Upper Mercer coal and since it represents an abnormal condition of the strata, will not likely prove to be of wide extent. It was observed only along the Tygart Valley river in the region of Powell, Hammond and Valley Falls. The same clay was noticed on Lost run, near its mouth, where it was 2 feet thick.

The Upper Mercer Coal.

The **Upper Mercer coal,** which underlies or replaces the Hammond fire clay is the most important of the entire Mercer group. It is usually multiple-bedded, having such a variable number of slate and shale partings that no type section would represent it. The many partings detract greatly from its value as it is impossible to mine the coal without mixing some of the impurities with it.

The crop of the Upper Mercer coal is not shown on Map II, but it can easily be determined at any point by placing it about 90 feet below the base of the Allegheny series as shown

on Map II. It rises to the surface in eastern Monongalia county, eastern Marion and northern Taylor.

The stratigraphic position of this coal is shown in the geologic section for Powell, where it has a good development. It appears in a few oil well records, but aside from its nominal thickness, as recorded by the drillers, its extent and value are too speculative for intelligent discussion.

In **Monongalia county** the Upper Mercer coal was once prospected on the land of John Shaffer, 1.5 miles northwest of Rohr, but the opening was apparently unsuccessful.

This bed has been mined on the land of Robert Keener, ¾ mile southwest of Sturgisson, where Reger measured the following section:

	Ft.	In.
Shale, gray with iron ore at base	3	0
Fire clay, flinty, Mt. Savage?	7	0
Slate, black 0′ 3″		
Coal, medium, hard, good 1 7	4	2
Shale, gray 0′ 6″ to 0 10		
Coal, good, 1′ 0″ to 1 6		
Pavement?		
(Elevation, 2015′ A. T., Aneroid).		

Whether the fire clay in the section above is the Mt. Savage or Hammond is open to question, but it is named as the Mt. Savage because the Hammond fire clay and the Upper Mercer coal do not usually appear in good thickness at the same point.

On the land of George Cohens, 0.8 mile westward from Mack, Reger obtained the following section of the Upper Mercer coal:

	Ft.	In.
Fire clay, flinty, impure, Mt. Savage?	5	0
Coal, soft 1′ 7″		
Shale, gray 1 8		
Coal, soft 0 10	7	9
Shale, gray 2 2		
Coal, hard 1 6		
(Elevation, 1995′ A. T., Aneroid).		

On the land of George Wolt, ¼ mile southwest of Mack, Reger measured the following section of the Upper Mercer coal at a mine that is now abandoned:

	Ft.	In.
Sandstone, massive, Homewood.....		
Concealed with streaks of coal at base.....	20	0
Draw slate, visible.....	0	6
Coal, soft.....1′ 0″		
Shale, gray.....1 5		
Coal, soft.....0 10	5	8
Slate, black, hard....0 1		
Shale, gray.....1 3		
Coal, hard.....1 1		
Concealed pavement?		

(Elevation of coal, 2160′ A. T., Aneroid).

The three foregoing sections show that the Upper Mercer coal in this locality has an exceptionally good development and will afford much valuable fuel.

In Clinton district, on the head of Booth creek, one mile north of Halleck, the Upper Mercer coal has been prospected on the land of Elijah McCray, where it shows the following section:

	Ft.	In.
Sandstone, coarse, white, pebbly, Homewood.....	50	0
Concealed	5	0
Shale, dark and sandy, laminated.....	10	0
Coal .....1′ 4 ″		
Slate, gray.....0 0½		
Coal 0 7	3	10
Coal, bony.....0 4		
Slate, gray.....1 0		
Coal, slaty.....0 6½		
Fire clay.....	2	0
Concealed to Booth Creek.....	10	0

(Elevation of coal, 1470′ A. T., Aneroid).

In the same district, on the head of Booth creek, 2.4 miles southeast of Clinton Furnace, the Upper Mercer coal was prospected and tested thoroughly by George Gilmore on the land of Jacob Keys, formerly known as the Berkshire tract, where Reger secured the following data:

Jacob Keys Mine, Upper Mercer Coal.—No. 100 on Map II.

		Ft.	In.
1.	Sandstone, massive, making cliff, Homewood		
2.	Concealed, black slate at base.....	60	0
3.	Coal, good.....1′ 1″		
4.	Slate 0 0½		
5.	Coal, good.....2 0		
6.	Shale, gray, hard.1 6		
7.	Coal, very slaty and impure with streaks of sulphur.....1 6	9	5½
8.	Coal, hard.....0 6		
9.	Slate 2 0		
10.	Coal 0 10		

(Elevation, 1640′ A. T., Aneroid).

Nos. 9 and 10 of section were concealed, but supplied by Mr. Mitchell who worked in the mine. A sample was collected from Nos. 3, 5, and 8, the composition of which, as reported by Messrs. Hite and Krak, is given under No. 100 (Laboratory No. 652-H) in the table of coal analyses.

This coal was prospected by Granville Brown, one-half mile northeast of the McCray opening, but the presence of water prevented a thorough test.

The two sections and the Brown prospect indicate the presence of a considerable body of Upper Mercer coal in Clinton district between the headwaters of Booth creek and Field creek.

In **Marion county** the Upper Mercer coal appears on Grassy run, in Union district, one-half mile northwest of Samaria, where it has the following section:

	Ft.	In.
Slate shale, dark, laminated.....	15	0
Sandstone, massive.....	4	0
Coal .....1′ 0″		
Shale, gray.....1 6		
Coal 0 3	4	1
Shale, gray.....0 6		
Coal 0 10		
Fire clay.....	3	0
Sandstone, massive, to run.....	8	0

(Elevation of coal, 1030′ A. T., Aneroid).

The coal here has too much slate to make it of value for mining purposes.

One-fourth mile south of Samaria, on Long run, a hole was sunk through the Upper Mercer coal which lies just below drainage at that point. The opening was full of water and the character of the coal could not be obtained.

This bed was once mined on a commercial scale by the Powell Coal & Coke Company, on the Tygart Valley river at Powell. There the coal is only 6 feet above the river and it was mined by a slope. The mine is abandoned and had fallen shut, but Mr. R. W. Keener, watchman, gave the following section:

	Ft.	In.
Slate		
Coal, 3′ to 4′ 0″		
Slate, 1 6	9	6
Coal, 3′ to 4 0		

(Elevation, 887′ A. T., Hand Level).

Three-fourths mile west of Hammond the Upper Mercer coal has the following section:

	Ft.	In.
Fire clay		
Coal, bony, 18″ to 2′ 0″		
Slate, black, 0 2		
Coal, soft, 2 3	5	5
Slate, black, 1″ to, 0 2		
Coal, blocky, hard, 0 10		
Fire clay, medium	3	0
Sandstone, flaggy, dark	4	0
Shale, sandy and hard	5	0
Shale, sandy, softer	5	0
Limestone, ferriferous, hard	0	6

(Elevation of coal, 945′ A. T., Aneroid).

On Glady creek, 0.8 mile east of Hammond, the Upper Mercer coal is mined and has the following section:

	Ft.	In.
Coal, 0′ 10″		
Slate, black, 0 2		
Coal, slaty, 1 6		
Slate, dark gray, 0 6	9	4
Coal, slaty, 1 0		
Coal, soft, 2 4		
Slate, black, 0 3		
Coal, harder, 2 9		

(Elevation, 1080′ A. T., Aneroid).

In **Taylor county** the following section of the Upper Mercer coal was measured, 1.3 miles southwest of Valley Falls, at an old mill on the Charles Barker property:

		Ft.	In.
1.	Sandstone, massive, visible	10	0
2.	Shale, sandy	1	6
3.	Limestone, very ferriferous, 6″ to	0	8
4.	Shale, gray, with large boulders of iron ore	4	0
5.	Limestone, ferriferous	0	4
6.	Shale, sandy, dark	1	0
7.	Sandstone, massive	12	0
8.	Shale, dark, sandy, with fossil plants	3	0
9.	Coal 0′ 2″		
10.	Slate, gray 0 2		
11.	Coal, bony 0 3		
12.	Coal 2 0		
13.	Coal, bony 0 2	4	2
14.	Shale, gray 0 5		
15.	Coal 0 4		
16.	Shale, with streaks of coal 0 8		
17.	Shale, hard	2	0
18.	Sandstone to run	2	6

(Elevation of coal, 1005′ A. T., Aneroid).

A sample of the ferriferous limestone, No. 3 of section, was collected and its partial analysis as reported by Messrs. Hite and Krak under Laboratory No. 591-H is as follows:

	Per cent.
Silica (SiO_2)	17.45
Metallic Iron	41.11
Lime (Ca O)	1.76
Sulphur	0.89
Phosphorus	0.82

At an exposure of the Upper Mercer coal along the public road, ½ mile southeast of Valley Falls on the south side of the river, Reger measured the following section:

	Ft.	In.
Sandstone, massive, visible	15	0
Coal, slaty 1′ 1″		
Slate 0 0½		
Coal, good 2 4	4	3½
Slate 0 4		
Coal 0 6		
Concealed to river	8	0

(Elevation of coal, 980′ A. T., Aneroid).

On the south side of the river at the falls the Upper Mercer coal has been mined in an abandoned railroad cut, the character of which may be seen by reference to the Valley Falls section on a previous page of this chapter. At that point Reger collected a sample from No. 14 of section and another from No. 16, the composition of which as reported by Messrs. Hite and Krak is given under No. 101 (Lab. Nos. 606-H and 607-H, respectively) in the table of coal analyses.

The foregoing sections show a considerable amount of Upper Mercer coal easily available for use at Valley Falls. The value of the coal, however, is seriously decreased by the fact, previously mentioned, that the Hammond fire clay often replaces it almost completely, a condition that interferes greatly with its value as a mining proposition.

The Lower Mercer Limestone.

The Lower Mercer limestone, which appears in the Pottsville series a short distance below the Upper Mercer coal, was noted at only a few points along the Tygart Valley river. Its place in the measures is shown by the geologic section for Powell. It is usually ferriferous and hard and seldom reaches 1 foot in thickness. According to I. C. White[1], this limestone carries abundant evidence of fossil life in western Pennsylvania and southern Ohio, but no trace of fossils was found in the Tygart Valley region.

The Lower Mercer Coal.

The Lower Mercer coal, which occurs beneath the Lower Mercer limestone, is too thin and irregular to be of commercial or stratigraphic importance. Its position in the Pottsville series is shown by the geological section for Morgans Run and Powell, where it probably reaches its maximum development. In most of the regions where its horizon is above drainage, it was not found.

A section made along the Tygart Valley river, one-third mile below Hammond, shows the following:

1. Bulletin 65, U. S. G. Survey, page 200.

PLATE XXIII(a).—Upper Connoquenessing Sandstone, capping Mitchell Knob at the northeast corner of Monongalia County.

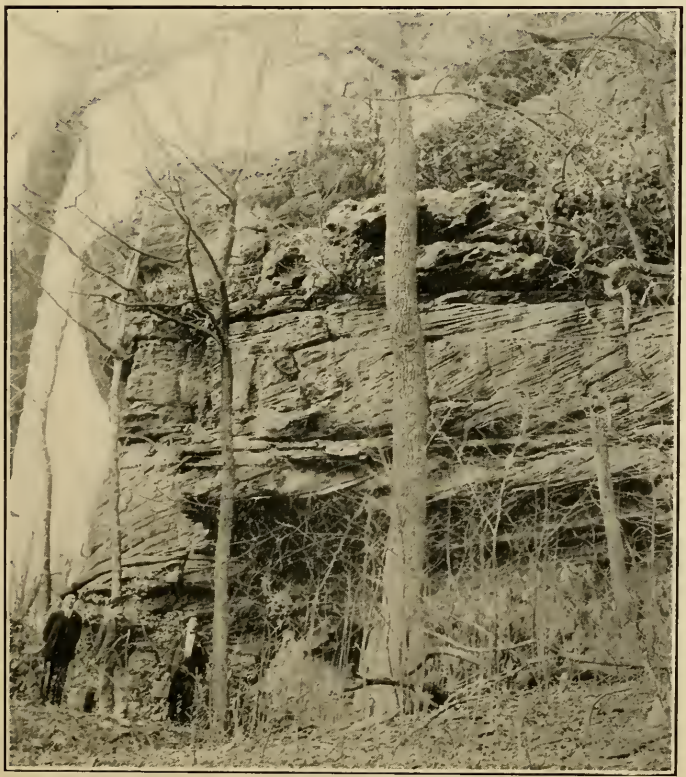

PLATE XXIII(b).—Upper Connoquenessing sandstone showing cross-bedding at Cooper Rock, Monongalia County.

	Ft.	In.
Shale, sandy, dark	10	0
Limestone, dark, ferriferous, hard, Lower Mercer 2″ to	0	6
Shale, gray	1	0
Slate, black 2′ to	2	6
Coal, Lower Mercer	0	2
Fire clay, flint	4	0

(Elevation of Lower Mercer coal, 940′ A. T., Aneroid).

This section shows not only the Lower Mercer limestone and the Lower Mercer coal, but also a flint fire clay that is below the horizon of the Mt. Savage or Hammond. The presence of fire clay is a feature that is a characteristic accompaniment of many exposures of the Mercer group of coals.

The Upper Connoquenessing Sandstone.

The Upper Connoquenessing sandstone, which was first studied, named and described by I. C. White in Lawrence county, Pennsylvania, is the most persistent and characteristic stratum of the entire Pottsville series in the territory of this report and is largely responsible for the rough topography that is invariably found where the series is above drainage. It is usually light gray in color, very hard and resistant to weather, quite often has large angular quartz pebbles scattered throughout its mass, and abounds in the plant fossils of the coal measures, lepidodendra and sigillariae being the most noticeable. It usually forms a bold cliff along the hillsides and the talus from it litters the slopes and watercourses below. This sandstone crops across Monongalia county from the Pennsylvania line to Deckers creek, appears in the hills of eastern Marion county and goes below drainage for the last time at Valley Falls on the Taylor county line. At the government triangulation point on Mitchell Knob near the common corner to Monongalia, Preston and Fayette counties, it forms the top of the mountain close to the axis of the Chestnut Ridge anticline where its thickness is nearly 100 feet and its top is 2600 feet, aneroid, above sea level. At Valley Falls, 23 miles to the south, and also near the axis of the anticline, the top of the sandstone is only 975 feet, the dip of the axis being

70 feet to the mile. Its stratigraphic position and thickness may be seen by reference to the geological sections in chapter IV for Morgans Run, Mont Chateau, Quarry Run, Cheat View, Beaverhole, Rohr, Morgantown, Sturgisson, Glover Gap, Whetstone Run, Downs, Montana Mines, Powell, and Stonehouse.

In eastern **Monongalia county** the Upper Connoquenessing sandstone forms the mountain tops from the Pennsylvania state line southward along the Preston county line to Cheat river. On Cheat river it rises above drainage just below Mont Chateau and from this point it rises rapidly southeast to the Chestnut Ridge anticline and remains high in the hills all the way to the Preston county line. It is this great sandstone that forms both Cooper Rock, north of the river, and Cheat View, south of the river, twin sentinels of stone that, together with the cliffs of which they are a part, have ever been the delight of the tourist.

The Upper Connoquenessing sandstone forms another picturesque gorge on Deckers creek. It rises from the creek a short distance east of Dellslow where it may be seen on either side of the creek, separated from the Homewood sandstone above it by only about 20 feet of a scarcely percepitble shale parting. As the stratum rises to the southeast toward the Chestnut Ridge anticline, it splits into two members, both of which are easily visible from the Morgantown and Kingwood railroad. The lower cliff, which is the Lower Connoquenessing sandstone, will be described later. The Upper Conquenessing is quarried for glass sand by the Deckers Creek Stone & Sand Company at Sturgisson, where it is 65 feet thick. Its character at that place will be described in detail in Chapter XIII. The stratum remains above drainage on Deckers creek all the way to the Preston line.

In **Marion county** the Upper Connoquenessing sandstone crops along Prickett creek, at the Winfield-Union district line, from Samaria to Dunham Lick run. At the Vincent Heirs gas well (683), which starts 10 feet above the sandstone, it is 74 feet thick.

On Tygart Valley this sandstone crops in the river just

PLATE XXIV.—Upper Connoquenessing Sandstone at Valley Falls, on the Tygart Valley River. Topography of the Allegheny and Pottsville Series in background.

below Hammond, rises rapidly southeastward to the axis of the Chestnut Ridge anticline, and passes under drainage at Valley Falls which it forms. The river between these two points is thickly strewn with boulders that have fallen from the cliff.

The Quakertown Coal.

Below the Upper Connoquenessing sandstone a coal that was named the **Quakertown** by I. C. White is sometimes found. It is inconspicuous in the territory of this report and not important. It is noted in the geologic sections for Quarry run and Stonehouse. In the Vincent Heirs gas well (683), in Winfield district, Marion county, it is reported 7 feet thick at a depth of 64 feet.

The Lower Connoquenessing Sandstone.

The Lower Connoquenessing sandstone, which underlies the Quakertown coal from which it is separated by a short interval of shale, is not generally present in the territory of this report. It is similar in character to the Upper Connoquenessing, though it is not usually so thick and does not make such a marked feature of the topography. It is light gray in color, massive and hard, and often contains quartz pebbles.

The Lower Connoquenessing sandstone crops only in Monongalia county from the Pennsylvania state line southward to Deckers creek beyond which to the southwest it passes completely under drainage. Its stratigraphic position and thickness may be studied in the geologic sections for Morgans Run, Quarry Run, Downs and Montana Mines. This sandstone may be seen at a few points along Cheat river At Quarry run it is 10 feet thick, resting directly on the Mauch Chunk red shales.

The principal crop of Lower Connoquenessing sandstone noted was along the gorge of Deckers creek, where it is well developed. As stated previously, it separates from the Upper Connoquenessing about one-half mile east of Dellslow and

remains a distinct horizon until it goes under drainage in Preston county a short distance west of Cascade.

The Sharon Coal.

The Sharon coal, which in western Pennsylvania lies just beneath the Lower Connoquenessing sandstone, was not noted above drainage at any point and not appearing in any of the geologic sections, may therefore be considered as absent from the Pottsville series of this district.

The Sharon Conglomerate.

The Sharon Conglomerate, which in western Pennsylvania is the lowest member of the Pottsville series, is not often found in the territory of this report. It appears in the geologic sections for Morgans Run, Beaverhole, Sturgisson, Lick Run, and Stonehouse and may possibly be present in scattered oil well records west of its outcrop. It may be seen at Sturgisson well up the south hillside, along the incline of the Deckers Creek Stone & Sand Company, where it is the first sandstone visible when ascending the hill. Here it is 40 feet thick, massive, gray and pebbly, and is underlaid with a streak of coal about one-eighth of an inch thick.

At Lick Run the Sharon Conglomerate is high in the south hill, 15 feet thick, flaggy and gray, and lies 35 feet above the first visible red shales of the Mauch Chunk series.

PLATE XXV.—Topography of the Allegheny and Pottsville Series and debris from the Pottsville in the Tygart Valley River below Valley Falls.

CHAPTER X.

STRATIGRAPHY—MISSISSIPPIAN ROCKS.

The Pottsville series, described in the preceding chapter, is the last one that contains coal in the territory of this report. The three following series; viz., the Mauch Chunk, Greenbrier, and Pocono, are usually classed as the Mississippian, Lower or Sub-carboniferous rocks because the Pocono series in some parts of the Appalachian region contains coal.

The Mauch Chunk Series.

The Mauch Chunk series, which directly underlies the Pottsville, and which was named from the city of Mauch Chunk in eastern Pennsylvania, marks a complete lithologic change from the rocks above it. Neither the Allegheny nor the Pottsville series contains any reds, but red shale is the predominant feature of the Mauch Chunk. Since red beds are the result of oxidation, and oxidation of sediments usually takes place under atmospheric rather than aqueous agencies, the conclusion is apparent that the shales of the Mauch Chunk series, no matter what may have been their original color or condition, must have been exposed for ages to the action of the Paleozoic air.

The series crops in Monogalia county, mainly in the Cheat river canyon and the Deckers creek gorge, though there are a few isolated exposures farther north. Its crop is indicated on Map II. North of Cheat river these rocks may be seen near to the Pennsylvania line at the head of Ryan Hollow. They crop also on the head of Morgan run, Darnell Hollow, Johnson Hollow, and at several points on Quarry run. On Cheat river the Mauch Chunk rocks appear first at the mouth of Quarry run, and crop continuously on both sides of the river all the way to the Preston county line, four miles to

the southeast. In this region they are about 300 feet thick. On Deckers creek they crop continuously, from a point one-half mile east of Dellslow, for 3½ miles along the gorge all the way to the Preston county line. South of the Deckers creek gorge they do not crop in the territory of this report.

The stratigraphic position and thickness of the Mauch Chunk series may be studied in detail by reference to the geologic sections for St. Cloud, Cassville, Morgan Run, Quarry Run, Cheat View, Beaverhole, Rohr, Sturgisson, Glover Gap, Whetstone Run, Downs, Montana Mines and Stonehouse.

Reference to these sections will show that the Mauch Chunk series is only 123 feet thick at Glover Gap in western Marion and that it gradually increases in thickness to the southeast until at Sturgisson, in eastern Monongalia, it reaches 405 feet, the maximum thickness in the three counties.

As stated previously, the Mauch Chunk series is composed mainly of red shales. Quite frequently streaks of gray and brown shale appear and at an exposure on the Morgantown & Kingwood Railroad, ¾ mile southeast of Sturgisson, there is a considerable deposit of pale green shale. Near the same point there is a ledge of green flaggy, micaceous, fine-grained sandstone which is a typical feature of the Mauch Chunk series as it often contains streaks of sandstone that invariably correspond to this description. In the territory of this report the sandstones are not prominent. There is seldom more than one and it is lenticular in character, often changing to shale in a very short distance. The Maxton oil sand is a member of the Mauch Chunk series. A limy shale or shaly limestone, which is usually crowded with marine fossils, is often found in the lower half of the Mauch Chunk. The record of plant life is indistinct, having evidently been largely destroyed by the same oxidizing agency that affected the shales.

The Greenbrier Limestone.

The Greenbrier Limestone, named from its outcrop on the Greenbrier river in Greenbrier county, West Virginia, is the next formation below the Mauch Chunk shales. It was

PLATE XXVI.—Quarry in the Greenbrier Limestone at Sturgisson, Monongalia County. The Mauch Chunk Shales are visible above the limestone.

formerly known as the "Mountain Limestone" and among the oil well drillers in the western part of the State it is invariably recorded as the "Big Lime". In the territory of this report it has a thickness of from 80 to 150 feet. It is a hard calcareous stratum, some portions of which are nearly pure calcium carbonate. At the top it often contains streaks of red shale making it hard to distinguish the line of separation from the Mauch Chunk series above. Occasional sandy streaks appear in the lower portion and in some places it changes gradually to the sandy rocks of the Pocono series below, the conclusion being that it rests conformably upon the Pocono rocks. The calcareous portions are usually full of marine fossils in an excellent state of preservation, the more common forms being crinoids, pelecypods and brachiopods. The color of the limestone is usually dark gray, both on fresh fracture and when exposed to the weather.

The stratigraphic position and thickness of this stratum may be seen by referring to the geologic sections for St. Cloud, Cassville, Morgan Run, Quarry Run, Cheat View, Beaverhole, Rohr, Sturgisson, Glover Gap, Whetstone Run, Downs, Montana Mines and Stonehouse. It is also named in numerous oil well records that will be published in a subsequent chapter.

The Greenbrier limestone crops only in **Monongalia county** in the region between the Pennsylvania line and Deckers creek. By referring to Map II it will be seen that it crops in the head of Ryan Hollow, Morgan run and Darnell Hollow. In Darnell Hollow there is a small quarry operated for agricultural lime on the land of Wm. F. Darnell, where the following section was exposed:

		Feet.
1.	Concealed	..
2.	Reds	5
3.	Limestone, silicious	2
4.	Limestone, bluish gray	5
5.	Concealed	..

A sample collected here from No. 4 and reported by Messrs. Hite and Krak under Lab. No. 639-H gave the following analysis:

	Per cent.
Silicia (SiO_2)	5.65
Ferric Iron (Fe_2O_3)	0.86
Alumina (Al_2O_3)	1.44
Calcium Carbonate ($CaCO_3$)	85.34
Magnesium Carbonate ($MgCO_3$)	1.38
Phosphoric Acid (P_2O_5)	0.20
Loss on ignition	4.86
Total	99.73

On Cheat river the Greenbrier limestone appears above drainage one mile southeast of Mont Chateau and is exposed along the river all the way to the Preston county line, 3½ miles to the southeast. On Scott run at the county line, Reger measured the following section:

	Feet.
Limestone, fossiliferous, making cliff	70
Sandstone, brown, soft, pebbly	15
Limestone, hard	10
Concealed, mostly sandstone, Pocono	105
Sandstone, hard gray, medium grained, making falls, Pocono	60

On Deckers creek the Greenbrier limestone rises above drainage one mile north of Sturgisson and is exposed on both sides of the gorge until it passes beneath the creek level, 2½ miles to the southeast, ¼ mile west of the Preston county line. It is quarried at Sturgisson by the Deckers Creek Stone & Sand Company for ballast and concrete. Here it is fairly pure and the fossil marine life is abundant.

At Lick Run station boulders of this limestone are exposed and an attempt was made to open a quarry, but owing to the large amount of surface drift encountered, the project was abandoned.

The economic aspects and uses of the Greenbrier limestone will be discussed fully in a subsequent chapter.

The Pocono Series.

The Pocono series, which immediately underlies the Greenbrier limestone, and which was named from the Pocono mountains in northeastern Pennsylvania, is the lowest group

of rocks exposed in the territory of this report. As shown principally by oil well records, it has a thickness of about 500 feet, there being little variation from this figure.

The Pocono series consists of alternating beds of gray sandstones, sometimes pebbly, and gray or brown shales, with a few streaks of iron ore. In the upper portion there is often a calcareous member, making it hard to distinguish the line of division between the Pocono and the Greenbrier limestone above. No fossils were found in the series, but S. B. Brown, Professor of Geology at the West Virginia University, reports marine fossils at Beaverhole in Preston county near the Monongalia line.

The Pocono series has been of enormous economic importance in this territory, owing to the fact that it contains four oil sands; viz., the Keener, Big Injun, Squaw and Berea. Of these the Big Injun is the one most developed. West of the Monongahela river in Monongalia and Marion counties, it has produced oil and gas in greater quantity than any other sand.

The stratigraphic position and thickness of the Pocono series is given in the geologic sections for St. Cloud, Cassville, Morgan Run, Quarry Run, Cheat View, Beaverhole, Rohr, Glover Gap, Whetstone Run, Downs, Montana Mines, and Stonehouse. It is also given in numerous oil well records published in this report.

The Pocono series crops only in Monongalia county between the Pennsylvania line and Deckers creek. There should be a small area of these rocks exposed in the head of Ryan Hollow. On Cheat river, as shown on Map II, the Pocono rocks crop for three miles along the canyon next to the Preston county line.

On Scott run at the Preston line, Reger measured the following section of the Pocono series:

	Thickness. Feet.	Total. Feet.
Limestone, Greenbrier.....		
Concealed, mostly sandstone.....	105	105
Sandstone, hard, gray, medium grain, making falls.....	60	165
Slate, gray, with streaks of red.....	20	185
Shale, red	20	205

Sandstone, shaly	15	220
Shale, gray, with nodules of low grade iron carbonate	50	270
Concealed	85	355
Sandstone, hard, brown, making cliff	20	375
Concealed to Cheat river at Beaverhole	55	430

Owing to the dip of the rocks the thicknesses are only approximate. The iron ore noted in the section appears also in the section made by Reger on the opposite side of Cheat river, two miles north of Rohr.

On Deckers creek the Pocono series is exposed at Iron Bridge where the Chestnut Ridge anticline crosses Deckers creek. The outcrop extends for more than a mile along the creek, the maximum thickness above drainage being only 30 to 40 feet. The sandstone there is pebbly, hard, and white with streaks of green.

PART III.

Mineral Resources.

CHAPTER XI.

PETROLEUM AND NATURAL GAS.

As mentioned in other county reports, all the oil and gas yet discovered in West Virginia, with one or two exceptions, has been produced from sandstone beds, designated "sands" by well drillers. The Greenbrier limestone, or "Big Lime", has produced some dark, heavy oil in northern Calhoun and northeastern Roane counties, being the only calcareous stratum that has produced either oil or gas in the State. The following table, from page 271 of the Doddridge-Harrison Report of the State Survey, exhibits in descending order the position of the sands, or the oil and gas bearing horizons in West Virginia:

The Oil and Gas Horizons of West Virginia.

Carboniferous.	Monongahela Series	Carroll sand (Uniontown.
	Conemaugh Series	Minshall (Connellsville). Murphy (Morgantown). Moundsville (Saltsburg). First Cow Run (Little Dunkard) sand (Buffalo). Big Dunkard sand (Mahoning).
	Allegheny Series	Burning Springs (Upper Freeport) sand. Gas sand (Lower Freeport).
	Pottsville Series	Gas sand of Marion and Monongalia counties (Homewood), Second Cow Run of Ohio. Gas sand of Cairo. Salt sand of Cairo. Cairo?
	Mauch Chunk Red Shale	Maxton, Dawson, Cairo.
	Grenbrier Limestone.	"Big Lime"; not generally productive.
	Pocono Sandstones	Keener sand and Beckett sand of Milton. Big Injun sand. Squaw sand. Berea Grit.
Devonian.	Catskill Red Beds	Gantz sand. Fifty-foot sand. Thirty-foot sand. Stray sand Gordon sand. Fourth sand. McDonald or Fifth sand. Bayard or Sixth sand. Elizabeth or Seventh sand.
	Chemung and Portage Beds.	Warren First or Second Tiona, Speechley sand. No well defined oil or gas horizons yet discovered in West Virginia.

Oil and gas have been found in the area under discussion in the Moundsville (Saltsburg) sand just below the middle of the Conemaugh series down through the rock column to and including the Bayard or Sixth sand near the base of the Catskill measures. The Chemung and Portage rocks have been penetrated by two or three deep wells, but no producing

horizons have yet been encountered therein by the drill. The table below gives not only the sequence of the sands that have produced either oil or gas in the area, but the approximate interval of each in feet below the Pittsburgh coal—a widely used "key rock" by the drillers in these counties:

Approximate Interval from Pittsburgh Coal to Top of Oil and Gas Sands.

SANDS	In'r'l Feet	SANDS	In'r'l Feet
Murphy (Morgantown)	210	Squaw	1575
Moundsville (Saltsburg)	350	Berea Grit	1850
First Cow Run (Little Dunkard)	420	Gantz	1925
Big Dunkard (Mahonings)	500	Fifty-foot	1975
Gas sand (Lower Freeport)	600	Thirty-foot	2025
Second Cow Run (Homewood)	825	Stray	2080
Salt (Connoquenessings)	900	Gordon	2150
Maxton	1125	Fourth	2225
Keener	1350	Fifth or McDonald	2300
Big Injun	1375	Sixth or Bayard	2430
		Seventh or Elizabeth	2550

All the Carboniferous rocks have a tendency to thicken southeastward; hence, it is readily observed that no specific figures can be given for intervals below any key rock that will hold good over the entire area.

DESCRIPTION OF SANDS.

Conemaugh Series.

Murphy Sand.—This sand, correlating with the Morgantown sandstone of the Conemaugh series, ranges from 20 to 50 feet thick and belongs 175 to 200 feet below the Pittsburgh coal. It has produced oil near Moundsville, Marshall county, and Deems Ferry, Wirt county. In the area under discussion no oil in paying quantity has been produced from this horizon, but a small flow of gas has been encountered therein in a few wells, among which is the P. W. Yost No. 1 well (560), located 0.3 mile west of Fairview.

Moundsville Sand.—This sand, correlating with the Saltsburg sandstone of the Conemaugh series and belonging 325 to 360 feet below the Pittsburgh coal, has been so named from Moundsville[1], Marshall county, where it has produced considerable oil. So far as known to the writer it has proved productive at only one point in the area under discussion; viz., in the A. H. Heldreth No. 1 well (478), located 0.5 mile northwest of Margaret, Marion county, where a flow of gas was encountered by the Delmar Oil Company in a sand, 28 feet thick, the top of which comes 330 feet below the top of the Pitsburgh coal. There the driller wrongly correlated the horizon with the Little Dunkard sand.

I Cow Run (Little Dunkard) Sand.—At about 425 feet below the Pittsburgh coal there belongs an oil and gas producing stratum that has been designated by the drillers as the First Cow Run sand in Washington county, Ohio, and later, the Little Dunkard, in southeastern Greene county. This horizon correlates with the Buffalo sandstone of the Conemaugh series and not the Saltsburg as has been worked out in detail by the writer on pages 281-285 of the Wirt-Roane-Calhoun Rept. of the State Survey.

This sand is at present producing gas from three wells in the town of Westover, Monongalia county, which were drilled for water but proved to be gaseous. Each has sufficient pressure to provide domestic fuel for a household. There are two pays in the sand, the upper one being found about 100 feet underground and the lower one about 140 feet.

Big Dunkard Sand.—This sand, belonging about 500 feet below the Pittsburgh coal and correlating with the Mahoning sandstones of the Conemaugh series, was so named by the drillers in the early days of the petroleum industry from Dunkard creek, in southeastern Greene county, Pa., where much oil was produced from this horizon. The reader is referred to pages 285-286 of the Wirt-Roane-Calhoun Report of the State Survey for correlation details. The Alpheus Morris No. 2 well (306), located in Grant district, Monongalia,

1. Ray V. Hennen, Doddridge-Harrison Rept., W. Va. Geol. Sur., p. 273; 1912.

1.6 miles northeast of Hagans, reports two gas pays in this sand the top of which comes 518 feet below the top of the Pittsburgh coal. This is the only well noted in which oil or gas was recorded.

The Allegheny Series.

The **Burning Springs**[2] **(Upper Freeport)** sand is nonproductive in the area.

Gas Sand.—The term "Gas sand" has been applied to a gaseous stratum in Monongalia and Marion counties, belonging 600 to 650 feet below the Pittsburgh coal. It correlates with the Lower Freeport sandstone of the Allegheny series and ranges in thickness from 50 to 100 feet. The Iona Bowlby No. 1 well (255) in Cass district, Monongalia county, located 0.6 mile southwest of Bowlby, produces gas from this horizon (See log). A seven-barrel daily flow of oil was encountered in this sand in the P. W. Yost No. 1 well (560), located in Pawpaw district, Marion, 0.4 mile west of Fairview, where the stratum is 61 feet thick, 648 feet below the Pittsburgh coal. At the end of 12 days, however, it was not making ½ barrel. No paying wells have been encountered at this horizon in the area.

The Pottsville Series.

II Cow Run Sand.—This sand, belonging at the top of the Pottsville series, 825 to 850 feet below the Pittsburgh coal, and correlating with the Homewood sandstone, has produced a large amount of oil both in Ohio and West Virginia. Its true correlation has been worked out in detail by the writer in its type locality at Cow Run, Washington county, Ohio, and published on pages 287-290 and 281-285 of the Wirt-Roane-Calhoun Report of the State Survey. It is frequently mistaken for the Salt sand, 25 to 50 feet lower in the measures, and many of the oil and gas shows reported by drillers in the latter horizon probably belong in the II Cow Run.

2. Ray V. Hennen, Wirt-Roane-Calhoun Rept., W. Va. Geol. Survey, pp. 286-287; 1911.

Salt Sands.—The original Salt sand of the drillers correlated with the Upper Connoquenessing sandstone of the Pottsville series, but later the several sandstone ledges of these measures were called First, Second and Third Salt. They constitute the middle and basal portion of the latter series, and have produced a large amount of both oil and gas in the State.

In **Monongalia** a light show of oil is reported at this horizon in Union district, at the Francis Costolo No. 1 well (327), located at the mouth of Rubles run on the east bank of Cheat river.

In **Marion** a flow of gas was encountered in two different wells according to the logs furnished by the owners; viz., Joseph Hayhurst No. 1 (374), located 2 miles east of Brink, and M. S. Snodderly No. 1 (543), located on the head of Fleming fork, 2 miles southwest of Mannington.

Just across the **Taylor county** line in Preston a show of both oil and gas is reported in the Idell Debillier No. 1 well (720), located 0.5 mile southeast of Irondale.

No paying wells from these sands are reported in any of the three counties.

The Mauch Chunk Series.

Maxton Sand.—This sand, belonging near the base of the Mauch Chunk series about 1125 feet below the Pittsburgh coal, and ranging from 10 to 80 feet in thickness, has produced considerable oil and gas in Tyler, Wetzel, Roane and Calhoun counties. In the area under discussion it has not attained much economic importance in either Monongalia or Taylor, but in Marion it has produced both oil and gas in the southwest portion of Mannington district.

The Pocono Series.

Big Injun Sand.—This sand, belonging immediately under the "Big Lime" or Greenbrier limestone, 1300 to 1400 feet below the Pittsburgh coal and frequently attaining a thickness of 300 feet, is one of the most prolific oil and gas

horizons not only in the State, but in the area under discussion A glance at the table of wells for each county on subsequent pages of this report will readily show the depth to the top of the sand as well as the localities where it has proved productive. The Big Injun is a hard, fine-grained sandstone with usually two and sometimes three or four open, coarse and pebbly layers, filled with gas, oil or salt water, and called "pay" streaks by the drillers. In Monongalia and Marion counties it is often 140 to 150 feet thick without a break of slate, with a gas pay 15 to 25 feet from the top; the first oil pay, 60 to 75 feet from the top; and a second or big pay at 80 to 90 feet in the sand. Frequently a third pay occurs at about 110 feet from the top.

Along the western border of the State, thirty to forty feet of the top portion of this stratum is often separated from the main bed by 5 to 15 feet of dark slate, as happens at the southwest edge of the Sistersville oil field of Tyler county, where this top portion is known as the **Keener sand.**

Sometimes the bottom portion of the Big Injun is separated from the main bed by a layer of slate, 15 to 25 feet thick, this basal part then being designated the **Squaw sand.**

The Berea Grit.—The Berea Grit formation, belonging about 1850 feet below the Pittsburgh coal and at the base of the Pocono sandstone group, has produced a large amount of oil and gas in Pleasants, Wood, Ritchie, Lewis, Gilmer, Calhoun, Roane, Kanawha and Lincoln counties. In the area under discussion, although noted in many of the well records, it has generally proved non-productive.

Devonian—Catskill Series.

In the Catskill series of the Devonian rocks, eight different sands have produced either oil or gas in the three counties; viz., Gantz, Fifty-foot, Thirty-foot, Stray, Gordon, Fourth, Fifth or McDonald, and Sixth or Bayard.

Gantz Sand.—The Gantz sand, belonging near the top of the Catskill, about 1925 feet below the Pittsburgh coal and ranging from 20 to 40 feet thick, is the next oil and gas horizon below the Berea Grit, having been so named from a well

on the Gantz[3] farm at Washington, Pa., where it comes 1827 feet below the Pittsburgh coal. It appears to be the top portion of the Hundred-foot sand of Butler county, Pa. In the area under discussion no paying oil wells are reported at this horizon, but several good gas flows have been encountered. The table of wells for each county shows the regions in which it has proved productive.

Fifty-foot Sand.—This sand closely underlies the last formation described and appears to be the basal portion of the Hundred-foot sand of Butler county, Pa. It belongs about 1975 feet below the Pittsburgh coal, and in Monongalia and Marion counties it has produced gas at a few widely scattered wells. In Taylor two heavy gassers were encountered at this horizon in the J. F. Holt No. 1 well (690), located 0.7 mile southeast of Boothsville, and the U. S. Morrow No. 1 well (707), 1 mile east of Meadland.

Thirty-foot Sand.—The next oil and gas horizon below that last described is what is known as the Thirty-foot, being 20 to 40 feet in thickness and belonging about 2025 feet below the Pittsburgh coal. A large amount of oil has been produced from this horizon in western Marion county in the fields immediately northwest of Glover Gap and northeast of Rymer. This sand has generally proved non-productive in Monongalia and Taylor. The table of wells for each county shows its depth and the districts in which it has proved productive.

Gordon Stray Sand.—This sand appears to be a split off the true Gordon next below and belongs 5 to 40 feet above the latter and a few feet below the red shale separating it from the Thirty-foot above. It ranges in thickness from 10 to 40 feet and comes 1975 to 2100 feet below the Pittsburgh coal. Shows of oil and gas have been encountered at this horizon at several widely scattered wells in the three counties.

Gordon Sand.—This sand, belonging about 2150 feet below the Pittsburgh coal and ranging in thickness from 20 to 40 feet, is one of the most prolific oil and gas horizons in

3. Stone & Clapp, Bull. 304, U. S. Geol. Sur., pp. 35-36; 1907.

Pennsylvania and West Virginia, and likewise within the three counties under discussion. As with all the sands in the middle and basal portions of the Catskill series it is difficult of correlation and the name "Gordon" is applied indscriminately by drillers to the Stray, Gordon and Fourth. The table of well records for each county exhibits not only its depth, but the districts in which it is productive. The Campbells Run and Whetstone Run sands both belong at this horizon.

Fourth Sand.—The next oil and gas horizon below that last described is the Fourth sand, 50 to 75 feet lower in the measures and about 2225 feet below the Pittsburgh coal. It is also a very prolific oil and gas horizon in the State and especially in Monongalia and Marion counties. A belt of oil wells—1 to 2 miles wide—in this sand extends entirely across Monongalia from near Shamrock on Dunkard creek southwestward to the Monongalia-Marion county line due south of St. Leo. Another belt of wells in this sand occurs in the southeast corner of Clay district. It is also a great oil horizon on the waters of Flat run in Marion county. No wells are reported from this sand in Taylor. The table of wells for each county shows the localities where it is productive, as well as its depth.

Fifth or McDonald Sand.—The Fifth or McDonald sand, 20 to 50 feet thick and about 2300 feet below the Pittsburgh coal, is the next oil and gas horizon below that last described. The drillers of Monongalia and Marion counties have erroneously designated an oil bearing sand in the Fairview field as the Fifth, but the data given on pages 141-142 of Vol. I(A) of the State Survey reports, show the latter to be 100 feet higher in the measures, and the oil horizon to be the Bayard. The Fifth sand is an important gas horizon in each of the three counties, and the table of well records exhibits not only its depth, but the localities where it is productive.

Sixth or Bayard Sand.—This sand, belonging 2410 to 2425 feet below the Pittsburgh coal, is the deepest producing oil and gas horizon in the three counties. As mentioned above under the description of the Fifth sand, it is an important oil horizon in the Fairview field, coming there 100 feet below the

Fifth and 2410 feet below the Pittsburgh coal. The table of well records for each county exhibits its depth and the districts in which it is productive.

OIL AND GAS DEVELOPMENT.

Early History.

The early history of the oil and gas development in this area began in October, 1889, with the completion of the Hamilton No. 1 well (541), located 0.6 mile southeast of Mannington, Marion county, in which a flow of oil was encountered in the Big Injun sand. This test well was a successful attempt by I. C. White in the practical application of the principles embodied in the anticlinal theory in the discovery of oil and gas pools, a complete account of which is given on pages 54-60 of Vol. I(A) of the State Survey reports. Soon thereafter the Mt. Morris pool of Greene county, Pa., was extended southwestward in an unbroken belt of wells to a point six miles beyond Mannington. Later pools to be developed were the Flat Run, Campbells Run, St. Leo, Cross Roads, Klondike, Bula, and other minor pools, all of which will be discussed more in detail on subsequent pages.

MONONGALIA COUNTY WELL RECORDS.

As with similar reports prepared by the writer, the main source of information as to the thickness of the coals and other formations of economic interest where they lie deeply buried below drainage has been the logs or records of many wells bored for oil, gas and coal by both individuals and corporations, through the courtesy of whom the Survey has been enabled to collect a large number. Levels were taken on many of these wells while gathering data in the field. The records of the same are in most cases incomplete, in that generally only the Pittsburgh coal and the most important oil and gas sands are noted. The importance of keeping accurate logs of all strata penetrated is well set forth in the Preface to Vol. I(A) of the State Survey reports.

Photo by Ray Bricker.

PLATE XXVII.—Topography of the Dunkard Series and oil wells near head of Smoky Drain, 2 miles northwest of Cassville, Monongalia County.

The accompanying table contains the abbreviated records of about 250 wells in Monongalia county, as well as elevations on nearly 100 other wells the logs of which were not obtainable. The wells are numbered consecutively from 1 up to 344 and grouped largely by magisterial districts, the serial number in all cases corresponding to the number of the same well on Map II. Similar tables are given on subsequent pages for Marion and Taylor counties, and generally where one of these tabulated wells is mentioned in the text, the serial number is added therewith in parenthesis.

Under the column headed "Owner" in the Monongalia table, the following abbreviations are used:

Alpha	Alpha Oil Company.
Battelle	Battelle Oil Company.
Carnahan	Carnahan and Debendorfer.
Carnegie	Carnegie Natural Gas Company.
Carter	Carter Oil Company.
Chartiers	Chartiers Oil Company.
Consolidation	The Consolidation Coal Company.
Daybrook	Daybrook Oil Company.
Delmar	Delmar Oil Company.
Fisher	Fisher Oil Company.
Fort Pitt.	Fort Pitt Gas Company.
Globe	Globe Fuel Company.
Home Gas	Home Gas Company.
Hope	Hope Natural Gas Company.
Hukill	E. M. Hukill & Company.
Kuntz, Jr., & Co.	James Kuntz, Jr. & Company.
Mfrs. L. & H.	Manufacturers Light & Heat Company.
McDermott	Joseph H. McDermott.
Mississippi	Mississippi Glass Company.
Mt. Park	Mountain Park Land Company.
Phila.	Philadelphia Company of West Virginia.
Pure	Pure Oil Company.
Randall	Randall Gas & Water Company.
Round Bottom	Round Bottom Oil & Gas Company
South Penn	South Penn Oil Company.
Spindletop	Spindletop Company.
Syndicate	Syndicate Oil & Gas Company.
Thompson	Sterling and Thompson.
Tin Plate	American Sheet & Tin Plate Company.
Wheeling	[illegible] Natural Gas Company.
W. Va. T. & E.	West Virginia Traction & Electric Company.

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
1	John E. Snyder No. 1	Battelle	Cochran & Funk	1425B
2	B. Renner No. 1	Springhill (Pa.)	Meals et al.	1175B
3	K. Renner Heirs No. 1	Springhill (Pa.)	Mfg. L. & H.	1115B
4	S. L. S. Spragg No. 1	Battelle	Syndicate	1161L
5	Eli White No. 1	Battelle	Gibson	1075B
6	F. H. Hennen No. 1	Battelle	Carnegie	1110B
7	Jas. L. White No. 1	Battelle	Phila	1240B
8	John G. White No. 1	Battelle	Carnegie	1150B
9	Simon L. White No. 1	Battelle	Phila	1130B
10	Thos. White No. 1	Battelle	Mfg. L. & H.	1065B
11	F. M. Staggers No. 1	Gilmore (Pa.)	———	1130B
12	J. P. Hagan No. 2	Gilmore (Pa.)	Phila	1095B
13	J. P. Hagan No. 1	Gilmore (Pa.)	Phila	1040B
14	Hagan Taylor No. 1	Battelle	Ferguson	1029L
15	John W. White	Battelle	———	1130B
16	Wm. Porter No. 1	Gilmore (Pa.)	Carnegie	1165B
17	Ed. Clovis No. 1	Gilmore (Pa.)	Ferguson	....
18	Jacob Simpson No. 1	Gilmore (Pa.)	Hope	995B
19	John Lantz No. 2562	Gilmore (Pa.)	Phila	990B
20	T. W. Kinnan No. 1	Battelle	———	1060B
21	Eliza Wade No. 2348	Battelle	Phila	1020B
22	L. A. Stiles No. 1	Battelle	Hope	....
23	Minerva Hennen No. 1	Battelle	Hope	1050B
24	Jas. Hagan No. 1	Battelle	Carnegie	990B
24A	Solomon Russell No. 1	Battelle	Hope	1055B
25	Sol Shriver No. 1	Battelle	Hope	....
26	Mary A. Eakin No. 1	Battelle	Phila	1005B
27	Sol Shriver No. 2	Battelle	Hope	1015B
28	Sol Shriver No. 3	Battelle	Hope	....
29	Geo. W. Shriver No. 1	Battelle	Phila	1095B
30	Henry W. Haines No. 1	Battelle	———	....
30A	Jasper Shriver No. 1	Battelle	Phila	....
31	Alonzo Edwards No. 1	Battelle	Battelle	1065B
32	L. H. & R. Wilson No. 1	Battelle	South Penn	1159L
33	E. B. Bell No. 2239	Battelle	Phila	....
34	R. S. Clovis No. 1	Battelle	Fort Pitt	1045B
35	Elijah C. Clovis No. 1	Battelle	Mfg. L. & H.	1165B
36	Barney Renner No. 2238	Battelle	Phila	1402L
37	Barney Renner No. 2165	Battelle	Phila	1365L
38	Nancy Hostutler No. 1	Battelle	Mfg. L. & H.	1200B
39	Amon Johnson No. 1	Battelle	Wheeling	....
40	Nancy Johnson No. 1	Battelle	Mfg. L. & H.	1095B
41	J. H. Six No. 1	Battelle	Carnegie	1110L
42	Barrickman-Goodnight No. 1.	Battelle	———	1145B
43	Lewis Lemley No. 1	Battelle	Fisher	....
44	Jackson Hostutler No. 1	Church (Wetzel	Fisher	1510B
44A	Marion Henderson No. 2411	Battelle	Phila	....

Wells in Monongalia County

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
1200	9	2450	2810	.....	3338	.....	3390	Big I. gas and 4th oil..	1
951	7	2204	2893	3027	3075	3173	3208	Gord oil show.....	2
901	7	2160	.....	3060	3135	.....	.....	Big I., 4th and Eliz....	3
929	6	2184	2953	3095	3155	3195	3406	Big I., gas and 4th oil..	4
789	11	2087	.....	.....	.....	.....	2890	Big I. and Gnz. gas....	5
855	..	2115	2878	2974	3025	3109	3211	50-ft., 30-ft. and Gord gas.	6
984	8	2282	.....	3235	3276	.....	3520	Dry hole	7
880	8	2181	.....	3055	3150	3181	3308	Big I. gas show	8
845	..	2131	.....	3020	3080	3136	3163	Fifth gas	9
785	8	2050	.....	.....	.....	.....	2240	Big I. gas	10
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	11
805	8	2090	2852	3005	.....	.....	.....	Big I. and 50-ft. gas shows	12
740	7	2021	.....	.....	2950	3058	3343	Big I. and 5th gas.....	13
725	..	.....	.....	.....	.....	.....	.....	5th gas	14
830	..	.....	.....	.....	.....	.....	....	Non-paying gas	15
900	..	2200	.....	.....	.....	3185	3520	6th gas show	16
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	17
703	3	1965	.....	.....	.....	.....	2073	Big I. gas	18
710	..	1975	.....	.....	.....	.....	2003	Big I. gas	19
780	8	2059	.....	.....	.....	.....	2099½	Big I. gas	20
750	..	2033	.....	.....	.....	.....	2195	Big I. gas	21
800	..	2082	.....	.....	3027	3102	3280	Big I. and 5th gas	22
748	5	2034	2550	2939	2995	3942	3075	Big I., 4th and 5th gas.	23
717	..	2013	.....	.....	2923	2981	3264	Gnz. gas light	24
.....	.....	.....	.....	.....	.....	.....	.....	———	24A
1038	..	2305	.....	.....	3250	3337	3344	Gordon gas	25
780	..	2062	.....	.....	2995	3038	3161	Gnz oil show	26
781	8	2058	.....	.....	3012	3051	3075	Big I. oil, 50-ft. and 4th gas	27
772	9	.....	.....	.....	.....	.....	.....	———	28
866	7	2160	.....	3060	3090	3152	3180	Fifth sand	29
.....	.....	.....	.....	.....	.....	.....	.....	———	30
.....	.....	.....	.....	.....	.....	.....	.....	———	30A
840	10	2152	.....	.....	3046	3102	3300	B. I., Gnz., 50-ft. & 5th gas	31
970	..	2235	3000	.....	3210	.....	3465	B. I. 50-ft. and 4th gas..	32
857	..	2160	2775	.....	3090	.....	3267	4th gas	33
810	10	2075	.....	2955	3050	3075	3432	Big I. gas light	34
920	8	2208	.....	.....	.....	.....	2936	B. Dunk., Big I., 50-ft gas	35
1190	6	2430	.....	3326	3400	.....	3426	Dry hole	36
1151	.....	2421	.....	3285	.....	.....	3331	Gord. gas and 4th oil ..	37
995	5	2268	.....	3140	3224	3265	3587	50-ft. gas light	38
.....	.....	.....	.....	.....	.....	.....	.....	———	39
867	5	2132	2858	2955	3015	3075	3454	50- ft. gas	40
885	8	2135	.....	2945	3085	3145	3160	Gord. gas	41
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	42
1157	..	2436	.....	.....	.....	.....	2506	Big I. gas	43
1313	6	2568	.....	3438	3516	3570	3985	Big I. gas	44
920	..	2220	2945	3085	.....	3202	....	(30-ft.) gas	44A

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
45	Abe W. Whisler No. 2407....	Battelle	Phila	1170B
46	Jacob (B. F.) Liming No. 2..	Battelle	Fisher	1225L
47	Jacob (B. F.) Liming No. 1..	Battelle	Fisher	1370B
48	John M. Liming No. 2303....	Battelle	Phila	1130B
49	Sol S. Lemley No. 1.....	Battelle	Phila	1170B
50	Amy Maple No. 1.....	Battelle	Mfg. L. & H.....	....
51	Fred O. Liming No. 2326....	Battelle	Phila	1240B
52	Sol M. Shriver No. 2306.....	Battelle	Phila	1130B
53	John Estel Heirs No. 1.....	Battelle	Mfg. L. & H.	....
54	Haught Heirs No. 1.....	Battelle	Fort Pitt	1250B
55	A. J. Cumberledge No. 2...	Battelle	South Penn	1015B
56	Juretta Eddy No. 2.....	Battelle	South Penn	1275B
57	Accha Eddy No. 8.....	Battelle	South Penn	970B
58	Accha Eddy No. 9.....	Battelle	South Penn	1010B
59	Accha Eddy No. 4.....	Battelle	South Penn	....
60	Isaac Strosnider No. 4.....	Battelle	South Penn	990B
61	Jerry Meriner No. 1.....	Battelle	South Penn	1080B
62	Eb Bell No. 5.....	Battelle	South Penn.....	1115B
63	Eb Bell No. 4.....	Battelle	South Penn	928L
64	Eb Bell No. 1.....	Battelle	South Penn	1033L
65	Eli Collins No. 1.....	Battelle	South Penn	1120B
66	Rufus Bell No. 1.....	Battelle	Battelle	1095B
67	Rufus Bell No. 1.....	Battelle	South Penn	1040B
68	Rufus Bell No. 2.....	Battelle	South Penn	1030B
69	Rufus Bell No. 3.....	Battelle	South Penn	....
70	Milo Strosnider No. 1.....	Battelle	Battelle	1006L
71	Josephus Thomas No. 1....	Battelle	Phila?	1000B
72	Shriver-Haught No. 1.....	Battelle	Hope	....
73	Henry Fox Heirs No. 1.....	Battelle	South Penn	1120B
74	Zadoc Wise No. 1.....	Battelle	Battelle	1010B
75	Lewis Fox No. 1.....	Battelle	Phila	1040B
76	Ezra Cross No. 1.....	Battelle	Battelle	....
77	W. L. Fox No. 1.....	Battelle	South Penn	....
78	Sarah E. Eddy No. 11.....	Battelle	McDermott	1030B
79	Sarah E. Eddy No. 1.....	Battelle	McDermott	....
80	M. J. Garrison No. 1.....	Battelle	South Penn	1120B
81	Elihu Eddy Heirs No. 6.....	Battelle	South Penn	1160B
82	M. J. & J. L. Garrison No. 1831	Battelle	Hope	....
83	Lee V. Tennant No. 1.....	Battelle	South Penn	1050B
84	A. J. Corrothers No. 1.....	Battelle	South Penn	....
85	A. J. Corrothers No. 2.....	Battelle	South Penn	1090B
86	F. M. Efaw No. 1.....	Battelle	Mfg. L. & H.	....
87	F. M. Efaw No. 3.....	Battelle	Mfg. L. & H.....	1115L
88	Amon Johnson No. 2.....	Battelle	Mfg. L. & H.	1083L
89	Samuel Eakin No. 4.....	Battelle	South Penn	1155B
90	Samuel Eakin No. 1.....	Battelle	South Penn	1125B
91	Ewing Heirs No. 1.....	Battelle	South Penn	1135B

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
1015	..	2285	.....	3173	3208	.....	3282	4th gas	45
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	46
1195	5	2434	3228	3388	.....	.....	3448	———	47
946	..	2222	.....	.....	.....	.....	2319	Big I. gas	48
995	..	2267	3011	3155	3192	3240	3458	30-ft. gas and oil show.	49
1005	..	2303	3000	3130	3225	.....	3308	30-ft. gas	50
1070	..	2360	.....	3210	3305	.....	3487	6th gas light	51
935	..	2225	.....	3075	.....	.....	3095	Big I., 30-ft. and Stray gas	52
1342	6	2631	3358	3436	3526	3590	3745	5th and 6th gas light ..	53
1070	..	2380	.....	.....	3296	3340	3486	50-ft. and 6th oil shows.	54
720	..	2010	.....	2900	2970	.....	2994	Big I. gas & oil and.... 4th oil	55
900	..	2210	.....	.....	3150	3220	3237	Big I. gas, 5th oil	56
678	..	1940	.....	.....	2922	.....	2952	4th oil	57
730	..	2007	2735	2895	2964	.....	2988	4th oil	58
910	..	2180	.....	.....	3154	.....	3165	4th oil, 1300 bbls. daily .	59
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	60
792	..	.....	.....	2970	3033	.....	3050	50-ft. & Gord gas; 4th oil	61
830	..	2085	.....	.....	3062	.....	3085	4th oil	62
730	..	1990	.....	.....	2967	.....	2998	4th oil.....	63
740	..	2030	.....	2925	2982	.....	3012	4th oil	64
810	..	2090	.....	.....	3050	.....	3074	4th oil	65
804	8	2080	.....	2930	3040	.....	3086	4th oil	66
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	67
742	....	1991	.....	2877	2980	.....	3001	4th oil	68
848	..	2056	.....	.....	2242	.....	3100	4th oil	69
712	10	1980	.....	.....	2925	.....	3159	———	70
.....	.....	.....	.....	.....	.....	.....	.....	———	71
.....	.....	.....	.....	.....	.....	.....	.....	———	72
830	..	2090	.....	2925	3055	.....	3070	Big I. and 4th gas	73
744	10	.....	.....	.....	2938	.....	2986	4th gas and oil	74
.....	.....	.....	.....	.....	.....	.....	.....	———	75
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	76
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas., 4th oil.....	77
771	..	2078	.....	.....	3000	.....	3021	4th oil, 10 bbls.	78
974	..	2246	.....	3125	3192	.....	.....	Big I. and Gord. gas 4th oil	79
896	6	2180	.....	3042	3097	.....	3141	50-ft., Gord. gas and oil.	80
895	..	2163	.....	3043	3113	.....	3160	4th oil, 2700 bbls. daily..	81
1038	..	2320	3140	3248	3288	.....	3310	Big I., 50-ft. & 4th gas...	82
828	..	2115	.....	.....	3043	.....	3063	4th oil	83
.....	.....	.....	.....	.....	.....	.....	.....	Gord. sand oil	84
782	..	2088	2820	.....	3026	.....	3050	Fourth oil	85
924	..	2225	.....	3055	3129	.....	3147	Big I. gas, 4th oil.....	86
876	6	2170	.....	.....	3076	.....	3096	Gnz. and 4th oil	87
858	9	2150	.....	3007	3064	.....	3086	4th oil	88
962	8	2245	.....	.....	3120	.....	3194	Stray & Gord. oil	89
927	10	.....	.....	3081	.....	.....	3112	Gnz. gas, Gord. oil	90
924	..	2200	2969	3090	.....	.....	.....	Gnz. gas, Gord. oil	91

Summarized Record of

Map No.	NAME OF WEL	Location—District	OWNER	Elevation A. T.
92	M. J. Garrison No. 1	Battelle	South Penn	....
93	M. J. (Crocker) Garrison No. 1	Battelle	South Penn	1075B
94	M. J. Garrison No. 2	Battelle	South Penn	1055B
95	Joseph Estil No. 9	Battelle	South Penn	1105B
96	Wilson Haught No. 4	Battelle	South Penn	....
97	Wilson Haught No. 3	Battelle	South Penn	1160B
98	Granville Leggett No. 1	Battelle	Fleming	1105B
99	J. M. Hall No. 2	Battelle	Mfg. L. & H.	....
100	E. B. Hall No. 2	Battelle	Mfg. L. & H.	1130B
100A	Eli Delaney core test	Battelle	Thompson	1132L
101	E. B. Hall No. 1	Battelle	Mfg. L. & H.	1080B
102	J. M. Hall No. 1	Battelle	Chartiers	1070L
103	F. M. Renner No. 1	Battelle	South Penn	1103L
104	Wm. Kinney No. 2	Battelle	Mfg. L. & H.	....
105	Robt. Weir No. 2	Battelle	South Penn	1160B
106	Louie Haught No. 1	Battelle	South Penn	1410B
107	W. A. Yost No. 5	Battelle	South Penn	1295B
108	T. C. Gallagher No. 1	Battelle	South Penn	1630L
109	T. C. Gallagher No. 2	Battelle	South Penn	1622L
110	Anna Harvey No. 1	Battelle	South Penn	1120B
111	S. J. Harvey No. 7	Battelle	South Penn	1095B
112	Susan Ammons No. 1	Battelle	South Penn	1055B
113	Elizabeth Haught No. 1	Battelle	South Penn	1140B
114	S. J. Harvey No. 4	Battelle	South Penn	....
115	Anna Harvey No. 3	Battelle	South Penn	1235B
116	Jas. Brookover No. 3	Battelle	South Penn	1165B
117	Corbra Anderson No. 2	Battelle	South Penn	1617L
118	Corbra Anderson No. 3	Battelle	South Penn	1616L
119	Alice Pyles (Seth Tennant) No. 1	Battelle	Hope	1230B
120	Catherine Gump No. 3	Battelle	South Penn	1200B
121	Lewis Gump No. 3	Battelle	Easton et al?	....
122	Lewis Gump No. 1	Battelle	Easton et al	1185B
123	Haught & Walker No. 24	Battelle	South Penn	1420B
124	Haught & Walker No. 13	Battelle	South Penn	1220B
125	Denny Tennant No. 8	Battelle	South Penn	1515B
126	S. T. Fordyce No. 1	Battelle	South Penn	1535B
127	Jos. & W. L. Parks No. 1	Battelle	South Penn	1080B
128	Jas. Fox No. 1	Battelle	South Penn	1115B
129	Abraham Shriver No. 1	Battelle	South Penn	1090B
130	James L. Parks No. 1	Battelle	South Penn	1000B
131	R. S. Thomas No. 1	Clay	Mellon Bros.	968L
132	R. S. Thomas No. 1	Clay	Tim Ross	975L
133	Elizabeth Tennant No. 1	Clay	South Penn	975B
134	Jacob Minor Heirs No. 1	Clay	Carnegie	975B
135	Estella & R. S. Lantz No. 1589	Clay	Phila	....
136	Estella & R. S. Lantz No. 1575	Clay	Phila	955B

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	4th oil show	92
885	..	2180	2975	3034	3134	.....	3169	Gnz. and 4th oil	93
885	10	2175	.....	.....	3118	.....	3140	50-ft. gas, 4th oil	94
930	..	2210	.....	.....	3175	.....	3199	Big I. gas, 4th oil	95
1244	9	2545	3263	3391	3495	.....	3518	4th oil, 500 bbls.	96
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	97
816?	..	.....	.....	.....	.....	.....	.....	4th oil, light	98
1160	..	2450	3177	3323½	.....	.....	3344½	50-ft., 30-ft., & Gord. oil.	99
977	11	2252	.....	3122	.....	.....	3161	30-ft. & Gord. oil	100
925	..	2235	.....	3081	.....	.....	3107	Gord. gas and oil	101
.....	.....	.....	.....	.....	.....	.....	.....	———	100A
916	..	2228	.....	3072	3145	.....	3155	Gord. oil	102
928	..	2230	.....	3091	3179	.....	3198	Gord. & 4th oil	103
1216	..	2321	.....	3261	3358	.....	3383	Gord. & 4th oil	104
.....	.....	.....	.....	.....	.....	.....	.....	Gord. & 4th oil	105
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	106
1105	..	2398	2890	3264	3359	.....	3395	Gord. & 4th oil	107
1294	8	2580	.....	.....	3514½	.....	3540	Big I. and 4th oil.....	108
1292	..	2600	.....	.....	3513½	.....	3534½	4th oil.....	109
780	..	2080	.....	.....	2995	.....	3012	4th oil, 2200 bbls.	110
750	..	2045	.....	2960	2989	.....	3021	4th oil	111
675	..	.....	.....	.....	2925	.....	3175	5th gas show	112
793	..	2100	.....	.....	3015	.....	3073	4th oil	113
1145	..	2477	.....	3340	3361	3398	3408½	4th oil	114
920	..	2225	.....	.....	3130	.....	3152	B. I. & 50-ft. gas, 4th oil.	115
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	116
1315	10	2614	.....	3528	3528	none	3769	B. I. gas, 4th oil.....	117
.....	.....	.....	.....	.....	.....	.....	.....	4th oil	118
925	..	2181	.....	3131	3172	.....	3200	50-ft. gas.	119
890	..	2195	.....	.....	3117	.....	3206	5th sand oil	120
894	7	2190	.....	.....	3127	.....	3176	4th, 300 bbls.	121
870	10	2170	.....	.....	3105	.....	3162	4th oil, 65 bbls.	122
1104	..	2380	.....	3270	3315	.....	3525	4th and 6th oil	123
909	..	2183	.....	.....	3130	.....	3146	50-ft. gas, 4th oil, 500 bbls.	124
1210	..	2500	.....	.....	3429	.....	3438	4th oil, 20 bbls.	125
1256	10	2545	.....	3467	3493	.....	3515	4th oil, 427 bbls.	126
780	..	2050	.....	2980	.....	3090	3193	4th, 5th & 6th gas.....	127
.....	.....	.....	.....	.....	.....	.....	.....	———	128
780	..	2100	3795	.....	3007	.....	3048	4th gas, heavy	129
683	..	1963	.....	2842	2917	3070	3185	B. I. and 6th gas	130
640	..	1915	.....	.....	.....	.....	2096	B. I. gas	131
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	132
.....	.....	.....	.....	.....	.....	.....	.....	4th oil show	133
625	..	.....	.....	.....	.....	.....	.....	———	134
628	..	1948	.....	.....	.....	.....	2064	Big I. gas.....	135
570	..	1905	.....	.....	.....	.....	1990	Big I. gas	136

Summarized Record of

Map No.	NAME OF WELL	Location — District	OWNER	Elevation A. T.
137	Estella & R. S. Lantz No. 1576	Clay	Phila	953L
138	——— Strosnider No. 1	Clay	Scott	946L
139	Remembrance Lantz No. 3	Clay	Phila	1035B
140	Wm. Scott No. 1	Wayne (Pa.)	South Penn	1117L
141	Jos. Marshall No. 1	Clay	Phila	....
142	E. C. Henkins No. 1	Clay	Hope	1060B
143	Josiah Devine No. 1	Clay	Phila	1105B
144	J. W. Brock No. 1	Clay	South Penn	1030B
145	R. S. Lantz No. 1	Clay	South Penn	....
146	Marion Tennant No. 1	Clay	Hope	1425B
147	Sol Meyers No. 1	Clay	Carnahan	1104L
148	Sol Meyers No. 1	Clay	McDermott	1110B
149	Reason Sine No. 1	Clay	Carnahan	1239L
150	Alph Sine No. 1	Clay	Carnahan	1152L
151	Alph Sine No. 2	Clay	Carnahan	1274L
152	Asa Lemley No. 2	Clay	Carter	1195B
153	Jas. Lemley Heirs No. 1	Clay	Fisher	1225B
154	Asa Lemley No. 3	Clay	———	1235B
155	Asa Lemley No. 1	Clay	———	1345B
156	D. S. Lemley No. 2	Clay	South Penn	1335B
157	J. N. Wilson No. 1	Clay	Chartiers	....
158	D. S. Lemley No. 1	Clay	South Penn	1480B
159	D. S. Lemley No. 1	Clay	Chartiers	1165B
160	Isaac Cook No. 2	Clay	Daybrook	1220B
161	Isaac Cook No. 1	Clay	Daybrook	1215B
162	Marion Tennant No. 1	Clay	Chartiers	1160B
163	John Henderson Heirs No. 1	Clay	Chartiers	1020B
164	Mary Berry No. 1	Clay	Chartiers	990B
165	John Moore No. 1	Clay	Chartiers	960B
166	Daniel Moore No. 2	Clay	Chartiers	1060B
167	D. R. Wright No. 1	Clay	Hope	980B
168	Grant Stevens coal test	Clay	J. E. Barnes	960B
169	S. P. Tennant Heirs No. 1	Clay	Hope	955B
170	Etta Core No. 1	Clay	Hope	1100B
171	Etta Core No. 2268	Clay	Hope	1345B
172	Lee R. Shriver No. 2	Clay	South Penn	965B
173	J. O. & E. Price No. 1	Clay	McDermott	990B
174	Lee R. Shriver No. 3	Clay	South Penn	975B
175	A. B. Price No. 1	Clay	South Penn	....
176	Lee Shriver No. 1	Clay	South Penn	925B
177	Brown Heirs No. 1	Clay	South Penn	955B
178	John Blair No. 1	Clay	South Penn	....
179	Nicholas Fetty No. 1	Clay	South Penn	965B
180	E. B. Toothman No. 1	Clay	Pure	1110B
181	W. R. Shuman No. 4	Clay	South Penn	1335B
182	Wilson Heirs No. 11	Clay	South Penn	1635B
183	C. M. Toothman No. 4	Clay	Fisher	1055B
184	C. M. Toothman No. 1	Clay	Fisher	1055B
185	M. A. Ammons No. 3	Clay	South Penn	1082L

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
561	8	1880	.....	.....	.....	.....	1980	Big I. gas	137
555	..	.....	.....	.....	.....	.....	....	B. I. and 5th oil	138
640	..	.....	.....	.....	.....	.....	.....	Big I. gas	139
720	..	2035	.....	.....	.....	.....	3052	5th oil	140
.....	.....	.....	.....	.....	.....	.....	.....	———	141
717	11	.....	.....	.....	.....	.....	3220	Dry hole	142
737	..	.....	.....	.....	.....	.....	.....	———	143
660	..	1968	.....	.....	2948	.....	3163	Light gas	144
.....	.....	.....	.....	.....	.....	.....	.....	Oil show	145
1105	..	2385	.....	.....	3350	3400	3555	B. I. & 6th gas	146
744	..	2034	.....	.....	.....	.....	2162	B. I. oil	147
756	..	2051	.....	.....	.....	.....	2256½	B. I. gas, light	148
890	..	2185	.....	.....	.....	.....	2245	B. I. oil	149
800	..	2080	.....	.....	.....	.....	2214	B. I. oil	150
916	..	2109	.....	.....	3185	3246	3371	B. I. & 6th oil	151
846	9	2132	2930	.....	3116	.....	3447	B. I. gas	152
875	..	2155	.....	.....	.....	.....	2298	B. I. oil, light	153
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil, light	154
990	10	2295	.....	.....	.....	.....	2410	B. I. oil	155
1017	..	2290	.....	.....	.....	.....	2412	B. I. oil	156
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil	157
1155	..	2436	.....	.....	.....	.....	2542	B. I. oil	158
856	6	2116½	.....	.....	.....	.....	.....	B. I. oil	159
.....	..	.....	.....	.....	.....	.....	.....	B. I. oil	160
.....	..	.....	.....	.....	.....	.....	.....	B. I. oil	161
795	..	2100	.....	.....	3012	.....	3220?	B. I. & 6th gas	162
635	..	1932	.....	.....	.....	.....	3238	4th gas, B. I. & 6th oil	163
596	..	1895	.....	.....	.....	.....	2026½	B. I. gas	164
555	..	1860	.....	.....	2786	2824	3261	6th gas	165
572	..	.....	.....	.....	.....	3020	3045½	6th gas	166
507	..	1753	.....	.....	2715	.....	2919	B. I., Gord. & 6th gas	167
477	10	.....	.....	.....	.....	.....	488	———	168
467?	..	.....	.....	.....	.....	.....	....	———	169
624	..	.....	.....	.....	.....	.....	....	———	170
892	10	2145	.....	3120	3150	3188	3348	B. I. & 5th gas, 6th oil	171
535	..	1755	2570	2760	2790	2840	2960½	B. I. & 6th oil and gas	172
552	9	1820	.....	2675	.....	2835	3190	B. I. & 6th oil show	173
540	..	1790	.....	.....	.....	.....	2968	B. I. & 6th oil	174
.....	..	.....	.....	.....	.....	.....	.....	6th oil	175
535	..	1755	.....	.....	2760	2840	2960½	B. I. & 6th oil and gas	176
520?	..	1840	.....	.....	2740	2795	2830	B. I. oil, 5th gas	177
538	..	1820	.....	.....	.....	.....	2990	6th oil	178
.....	..	.....	.....	.....	.....	.....	.....	B. I. gas, 6th oil	179
676	..	1976	.....	.....	.....	.....	2086	B. I. & 6th oil	180
932	..	2232	.....	3142	.....	.....	3382	6th oil	181
1228	..	2512	.....	.....	3438	.....	3658	Oil, 12 bbls. daily at first	182
570	8	1895	.....	2780	2830	.....	3003	B. I. & 6th oil	183
575	..	.....	.....	.....	.....	.....	1300?	B. I. oil	184
575	..	1885	.....	.....	.....	.....	2012	B. I. oil	185

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
186	C. W. Yost No. 1	Clay	Hope	....
187	John T. Neeley No. 1	Clay	Carnegie	....
188	————	Clay	————	1480L
189	Arthela (James) Eddy No. 5	Clay	South Penn	1310B
190	Reason Tennant No. 4	Clay	South Penn	1470B
191	Daniel L. Toothman No. 12	Clay	South Penn	1660L
192	David L. Ammons No. 1	Clay	————	1085B
193	E. J. Ammons Heirs No. 7	Clay	Delmar	1160B
194	Arthela Eddy No. 8	Clay	South Penn	1170B
195	Presley Tennant No. 7	Clay	South Penn	1165B
196	Simeon Tennant No. 12	Clay	South Penn	1195B
197	Alcinda Lemley No. 2(?)	Clay	South Penn	....
198	Enoch Tennant No. 1	Clay	South Penn	....
199	Albert Tennant Heirs No. 3	Clay	South Penn	1105B
200	Malinda Tennant No. 3	Clay	South Penn	995B
201	Jos. Varner No. 5	Clay	Alpha	....
202	Mahala McCord Heirs No. 1	Clay	Chartiers	1350B
203	Noah Brewer No. 1	Clay	Hope	....
204	Asa Tennant No. 9	Clay	McDermott	1019L
205	Eliza Tennant No. 1	Clay	Carr Bros	985L
206	Mary E. Tennant No. 1	Clay	McDermott	985L
207	Minor Tennant No. 1	Clay	Chartiers	970B
208	Daniel Moore No. 2	Clay	Chartiers	1070B
209	Noah Wright No. 3	Clay	South Penn	....
210	D. J. Eddy No. 3	Clay	South Penn	1090B
211	D. J. Eddy core test	Clay	————	1058L
212	D. E. Cordray No. 4	Clay	South Penn	1391L
213	Simon Wildman No. 15	Clay	South Penn	1035L
214	C. E. Johnson No. 8	Clay	South Penn	1280B
215	C. E. Johnson No. 1	Clay	South Penn	1340B
216	C. E. Johnson No. 5	Clay	South Penn	1325B
217	M. C. Wildman No. 1123	Clay	Hope	1130B
217A	D. E. Lemley No. 1	Clay	Hukill	1000B
218	Benj. (Kate) Core No. 1	Clay	Chartiers	949L
219	Kate Core No. 2	Clay	Chartiers	950B
220	Asa Sutton No. 6	Clay	South Penn	1485B
221	C. C. Core No. 3	Clay	South Penn	1440B
222	Thos. Sutton No. 2	Clay	South Penn	1365B
223	C. C. Core No. 7	Clay	South Penn	1340B
224	J. C. and R. Morris No. 1	Clay	South Penn	1205B
225	Margaret Davis No. 1	Clay	South Penn	1100B
226	G. & L. Morris et al	Clay	South Penn	....
227	Margaret Davis No 2	Clay	W. Va. T. & E.	1110B
228	Thornton Miller Heirs No. 1	Clay	————	1140B
230	Martha A. Miller No. 1	Clay	W. Va. T. & E.	1225B
231	Aaron Hawkins No. 1	Clay	W. Va. T. & E.	....
232	Cal Hawkins No. 1	Clay	W. Va. T. & E.	....
233	M. A. Miller No. 2	Clay	W. Va. T. & E.	1015B
234	M. A. Miller coal test No. 9'	Clay	Consolidation	1010B

Wells in Monongalia County

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
698	..	2010	.....	.....	.....	.....	2123	B. I. gas	186
.....	..	.....	.....	.....	.....	.....	.....	B. I. gas	187
.....	..	.....	.....	.....	.....	.....	.....	———	188
716	..	1931	.....	.....	.....	.....	2135	B. I. oil	189
945	..	2238	.....	.....	.....	.....	2370	B. I. oil	190
1243	8	2550	.....	3440	3500	3663	3699	B. I. ad 6th oil	191
732	..	.....	.....	.....	.....	.....	.....	6th oil	192
678	6	1980	.....	.....	2910	.....	3093	6th oil and gas	193
.....	..	.....	.....	.....	.....	.....	.....	Big I. oil	194
577	..	1900	.....	.....	.....	.....	1987	Big I. oil	195
585	..	1900	.....	.....	.....	.....	2011	Big I. oil	196
.....	..	.....	.....	.....	.....	.....	.....	Big I. oil	197
1024	..	2330	.....	.....	.....	.....	2443½	Big I. oil	198
.....	..	.....	.....	.....	.....	.....	.....	Big I. oil	199
474	..	1790	.....	.....	.....	.....	1898	Big I. oil	200
.....	..	.....	.....	.....	.....	.....	2314	Big I. oil	201
905	..	2220	2966	3100	3149	3205	3528	Big I. oil, 6th gas	202
.....	..	.....	.....	.....	.....	.....	.....	Big I. oil.....	203
493	..	1800	.....	.....	.....	.....	1925½	Big I. oil	204
480	..	.....	.....	.....	.....	.....	1895½	Big I. oil, light	205
485	..	1795	.....	.....	.....	.....	1892	Big I. oil	206
480	..	1815	.....	.....	.....	.....	1888	Big I. oil	207
572	..	.....	.....	.....	.....	.....	3045½	6th gas, light	208
1055	..	2350	.....	.....	.....	.....	2486	Big I. oil	209
.....	..	1870	.....	.....	.....	.....	1956	Big I. oil	210
468	9	.....	.....	.....	.....	.....	477	———	211
805	..	2135	.....	.....	.....	.....	2259	Big I. oil	212
505	..	1800	.....	.....	.....	.....	1926½	Big I. oil	213
770	..	2062	.....	.....	.....	.....	2180	Big I. oil	214
.....	.....	.....	.....	.....	.....	.....	2218	Big I. oil	215
820	..	2105	.....	.....	.....	.....	2201	Big I. oil	216
675	8	1930	2660	2835	2912	2950	3355	Big I. gas and oil show..	217
.....	.....	.....	.....	.....	.....	.....	.....	Big I. oil	217A
512	..	1780	.....	.....	.....	.....	1909	Big I. oil show	218
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	219
920	..	2228	.....	.....	.....	.....	2360	Big I. oil	220
860	..	2160	.....	.....	.....	.....	2300	Big I. oil	221
.....	.....	.....	.....	.....	.....	.....	2228	Big I. oil	222
776	..	2080	.....	.....	.....	.....	2209	Big I. oil	223
590	..	1895	.....	2709	2870	2930	3040	Big I., Gnz., Gord. & 5th oil	224
.....	.....	.....	.....	.....	.....	.....	.....	5th oil and gas	225
.....	.....	.....	.....	.....	.....	.....	.....	———	226
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	227
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	228
577	8	1860	.....	.....	2840	2900	2929	Big I. gas	230
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas, light	231
586	8	.....	.....	.....	.....	.....	2034	Big I. gas	232
412	7	1670	.....	.....	.....	.....	1854	Big I. gas	233
346	5.9	.....	.....	.....	.....	.....	347.6	———	234

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
234A	D. F. Morris No. 2618	Clay	Hope	....
235	Newton Varner No. 1	Clay	Hope	....
236	H. P. Wilson No. 1	Clay	———	....
237	Jacob A. Eddy No. 1	Clay	Hope	1040B
238	Isaac S. Eddy No. 1	Clay	Carnegie	1170B
239	Asa Sutton No. 1	Cass	Hukill	1430B
239A	C. C. Core No. 2	Cass	South Penn	1355B
240	David Wise (J. Henderson) No. 4	Cass	Spindletop	....
241	W. P. Core No. 9	Cass	South Penn	....
242	Almeda Dorsey No. 1	Cass	———	1020B
243	M. L. Core No. 3	Cass	Duquesne	1120B
244	Donley & Core No. 1	Cass	W. Va. T. & E.	1020B
245	D. L. Donley	Perry (Pa.)	Hukill	920B
246	D. L. Donley	Perry (Pa.)	———	....
247	John Gump	Perry (Pa.)	———	....
248	I. Bowlby No. 1	Perry (Pa.)	W. Va. T. & E.	1310B
249	Roy McClernan No. 1	Perry (Pa.)	W. Va. T. & E.	1260B
250	Bowen Wade No. 2	Perry (Pa.)	Randall	1190B
251	I. Bowlby No. 3	Cass	W. Va. T. & E.	1130B
252	Spencer M. Cunningham No. 2	Cass	Mt. Morris	1195B
253	S. Wade No. 1	Cass	W. Va. T. & E.	1085B
254	Spencer Cunningham No. 1	Cass	W. Va. T. & E.	1255B
255	Iona Bowlby No. 4	Cass	W. Va. T. & E.	1220B
256	H. C. Bowlby No. 5	Cass	W. Va. T. & E.	....
257	E. Brand No. 2	Cass	W. Va. T. & E.	....
258	Geo. Weaver No. 1	Cass	W. Va. T. & E.	1180B
259	Wm. McCormick No. 2	Cass	W. Va. T. & E.	1245B
260	Frank McCormick No. 1	Cass	W. Va. T. & E.	1215B
261	John Brand No. 1	Cass	Home Gas	1230B
262	Mark Weaver No. 1	Cass	W. Va. T. & E.	1245B
263	Justus Brewer No. 1	Cass	W. Va. T. & E.	1000B
264	Jas. Kennedy No. 1	Cass	W. Va. T. & E.	925B
265	A. Cole	Cass	W. Va. T. & E.	....
266	Wm. Higgins No. 1	Cass	W. Va. T. & E.	975B
267	Mankedick Heirs coal test No. 3	Cass	Consolidation	963L
268	A. L. Sutton	Cass	W. Va. T. & E.	....
268A	Amasa Cole No. 1	Cass	Hukill	....
269	David Henderson No. 1	Cass	W. Va. T. & E.	1340B
270	Chas. E. Core No. 1	Cass	W. Va. T. & E.	1165B
271	Clark Lemley No. 1	Cass	W. Va. T. & E.	1230B
272	John Laird (E. Roach) No. 1	Cass	W. Va. T. & E.	1135B
273	Elza Davis No. 1	Cass	W. Va. T. & E.	1050B
274	Wm. H. Smith No. 1	Cass	W. Va. T. & E.	1155B
275	E. H. Clevenger No. 1	Cass	Randall	1170B
276	W. P. Everly	Cass	W. Va. T. & E.	....
277	James Sanders No. 1	Cass	W. Va. T. & E.	....
278	John Sanders	Cass	W. Va. T. & E.	....
279	Jasper Stone No. 1	Cass	Randall	895B

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
510	5	1800	.....	2629	2785	2841	2912	5th oil, Big I. gas	234A
579	..	1886	.....	.....	.....	.....	2059	Big I. gas	235
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	236
460	..	1735	.....	.....	2700	2815	2974	Dry hole	237
570	10	1860	.....	.....	2800	2875	3013	Big I. gas, light	238
.....	.....	.....	.....	.....	.....	.....	.....	Big I. oil	239
805	..	2088	.....	.....	.....	.....	2235	Big I. oil	239A
.....	..	.....	.....	.....	.....	.....	.....	Big I. oil	240
532	..	1840	.....	.....	.....	.....	1940	Big I. oil	241
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	242
.....	.....	.....	.....	.....	.....	.....	.....	Big I. oil	243
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas, light	244
368	..	1635	.....	.....	.....	.....	.....	Big I. oil, ...	245
.....	.....	.....	.....	.....	.....	.....	.....	Big I. oil	246
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	247
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	248
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	249
413	10	1740	.....	.....	.....	.....	1880	Big I. gas	250
376	8	1655	.....	.....	.....	.....	.....	Big I. gas	251
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas, light	252
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	253
520	10	1826	.....	.....	.....	.....	1963	Big I. gas	254
462	10	.....	.....	.....	.....	.....	1401	"Gas" sand gas.....	255
709	15	.....	.....	.....	.....	.....	....	Big I. gas	256
493?	..	.....	.....	.....	.....	.....	....	Big I. gas	257
444	..	1754	.....	.....	.....	.....	....	Big I. gas	258
466	8	1692	.....	.....	.....	.....	1932	Big I. gas	259
423	8	1748	.....	.....	.....	.....	1882	Big I. gas	260
.....	.....	.....	.....	.....	.....	.....	.....	Big I. gas	261
477	8	1786	.....	2695	2759	2816	2993	Big I. and Berea gas ..	262
220	10	1542	.....	2511	2551	2585	2720	Big I. gas, 6th oil	263
.....	.....	.....	.....	.....	.....	.....	.....	6th oil, B. I. gas	264
455	8	.....	.....	.....	.....	.....	.....	B. I. gas	265
178	8	1504	.....	.....	.....	.....	1636	B. I. gas	266
158	5.1	.....	.....	.....	.....	.....	1754	———	267
494	8	.....	.....	.....	.....	.....	.....	B. I. gas, light	268
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	268A
683	8	1976	.....	.....	.....	3030	3323	B. I. and 5th gas	269
470	..	1750	.....	.....	.....	.....	1891	B. I. gas	270
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	271
276	10	1596	.....	.....	.....	.....	1779	B. I. gas	272
178	11	1498	.....	.....	.....	.....	1635	B. I. gas.....	273
285	11	1529	.....	.....	.....	.....	1748	B. I. gas	274
310	10	1636½	.....	.....	.....	.....	1777	B. I. gas, light	275
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	276
.....	..	1215	.....	.....	.....	.....	1363	B. I. gas	277
170	7	.....	.....	.....	.....	.....	.....	B. I. gas	278
.....	.....	1325	.....	.....	.....	.....	1487½	B. I. gas	279

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
280	M. G. Murphy No. 2	Cass	Mississippi	910B
281	Peter Lazzell No. 1	Cass	Mississippi	1170B
281A	C. C. Lazzell No. 1	Cass	Randall	....
282	Mary Garlow No. 1	Cass	McClure	....
283	T. A. and J. F. Keenan No. 1.	Cass	W. Va. T. & E.	1035B
284	Wade & Lazzell	Cass	W. Va. T. & E.	....
285	Sam Lazzell No. 1	Cass	Globe	....
286	L. J. Lazzell No. 1	Cass	———	1000B
287	Marion J. Garlow No. 1	Cass	Carngeie	....
288	Marshall Garlow No. 1	Cass	———	1080B
289	Ephraim McElroy No. 1	Cass	Maple & Co.	....
290	Sanford Barrackman No. 1..	Grant	W. Va. T. & E.	1085B
291	L. S. Bircher No. 1	Grant	W. Va. T. & E.	1335B
292	J. H. Cole coal test No. 2	Grant	Consolidation	1058L
293	Eugene Snyder No. 1	Grant	W. Va. T. & E.	....
294	J. C. Brand No. 2	Grant	W. Va. T. & E.	....
295	Eugene Snyder No. 1	Grant	Hope	....
296	L. B. Brand No. 1	Grant	W. Va. T. & E.	....
297	Jehu Davis No. 1	Grant	Hope	1440B
298	Martha A. Miller No. 2	Grant	W. Va. T. & E.	1255B
299	J. N. Michael No. 1	Grant	Carnegie	1215B
300	J. N. Michael No. 1998	Grant	Hope	1305B
301	J. N. Michael No. 1	Grant	Hope	1330B
302	J. N. Michael No. 2	Grant	Carnegie	1175B
303	J. N. Michael coal test No. 4	Grant	Consolidation	1169L
304	J. N. Michael No. 1	Grant	Brock & Courtney	1260B
305	J. N. Michael No. 3	Grant	Carnegie	1265B
306	A. Morris (No. 3)?	Grant	W. Va. T. & E.	1280B
307	A. Morris No. 2?	Grant	W. Va. T. & E.	....
308	J. E. Lynch coal test No. 5	Grant	Consolidation	1068L
309	S. C. Stewart coal test No. 8..	Grant	Consolidation	1083L
310	W. M. Michael coal test	Grant	———	1060B
311	Mary Lynch coal test No. 10.	Grant	Consolidation	980L
312	Benj. J. Miller No. 1	South Run	Consolidation	951L
313	C. M. Arnett coal test No. 7..	Grant	Consolidation	999L
314	A. C. Barker coal test No. 6..	Grant	Consolidation	1005L
315	E. W. Brand coal test No. 1..	Grant	Round Bottom	1050B
316	Jesse Camp No. 1	Grant	McDermott	925B
317	J. W. Holland No. 1	Grant	Mississippi	875B
318	Peninsula Company No. 1	Grant	H. C. Greer	986L
319	Yost coal test	Union	H. C. Greer	935B
320	McClaren coal test	Union	Globe	808L
320A	Jos. & David Krepps No. 1..	Morgan	H. C. Greer	806L
321	David Rich coal test	Union	Randall	925B
321A	Wayne Wilson No. 1	Union	———	810L
322	Van Voorhis coal test	Union	Randall	....
322A	D. M. Heard No. 1	Union		

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
12	10	1335	.....	.....	.....	.....	1490½	B. I. gas	280
229	13	1566	.....	.....	.....	.....	1696	B. I. gas	281
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	281A
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	282
117	7	1452	.....	.....	.....	.....	1592	B. I. gas	283
94	6	1432	.....	.....	.....	.....	1580	B. I. gas	284
5	10	.....	.....	.....	.....	.....	.....	B. I. gas	285
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	286
88	6	1454	.....	.....	.....	.....	1604	B. I. gas	287
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas, light	288
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	289
273	8	1625	2300	.....	2482	2590	2785	B. I. gas, light	290
563	9	1900	2490	2692	2772	2862	3066	B. I. and Gnz. gas	291
300	14.2	.....	.....	.....	.....	.....	315.6	———	292
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas, good	293
665	9	1975	.....	.....	.....	.....	2151	B. I. gas	294
437	9	1750	2465	.....	2734	2803	2892	B. I. and 5th gas	295
424	..	1762	2535	2573	.....	2790	2961	B. I. and Berea gas ...	296
811	10	2136	2832	.....	3100	3153	3227	B. Dunk, and 5th gas..	297
600	..	1899	.....	2800	2896	2945	2980	B. I., Stray and 5th gas.	298
557	..	1864	.....	.....	.....	2897	2925	5th gas	299
674	8	1963	.....	.....	2952	3004	3177	B. I. and 5th gas	300
684	8	1990	2675	.....	2965	3024	3211	B. I. and 5th gas	301
495	5	1800	.....	.....	2793	2850	2887	5th gas	302
498	..	.....	.....	.....	.....	.....	....	———	303
.....	.....	.....	.....	.....	.....	.....	.....	B. I. and 5th, light gas..	304
730	6	2040	.....	.....	.....	.....	2172	B. I. gas	305
592	8	1905	2585	.....	2870	2943	2980	B. Dunk., B. I. and Gnz. gas	306
553	8	1905	.....	.....	.....	2870	2980	B. I. gas	307
353	8	.....	.....	.....	.....	.....	363.5	———	308
401	15.2	.....	.....	.....	.....	.....	417.7	———	309
372	.....	.....	.....	.....	.....	.....	.....	———	310
262	8	.....	.....	.....	.....	.....	272	———	311
.....	.....	.....	.....	.....	.....	.....	.....	Light gas	312
223	94	.....	.....	.....	.....	.....	223.6	———	313
.....	13	.....	.....	.....	.....	.....	284	———	314
205	16	.....	.....	.....	.....	.....	222.2	———	315
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	316
.....	.....	1315	.....	.....	.....	2307	2616	Squaw gas, light	317
.....	.....	.....	.....	.....	.....	.....	(1200)	B. I.? gas.....	318
.....	.....	.....	.....	.....	.....	.....	365	———	319
.....	.....	.....	.....	.....	.....	.....	396	———	320
.....	.....	1012	.....	.....	1820	.....	2251	B. I. gas, light	320A
.....	.....	.....	.....	.....	.....	.....	235	———	321
.....	.....	1112	.....	.....	.....	2121	2280.5	B. I. gas, light	321A
.....	.....	.....	.....	.....	.....	.....	306¾	———	322
.....	.....	1258	.....	.....	.....	.....	1461.5	B. I. gas, light	322A

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
323	Van Voorhis & Bailey No. 1..	Union	W. Va. T. & E.	810B
324	Ed. White No. 1.....	Union	Kuntz, Jr., & Co.	840B
325	Thos. Manning No. 1.....	Union	———	710B
326	Francis Costolo No. 1.....	Union	Brooks Bros.	808L
327	Francis Costolo No. 1.....	Union	———	....
328	Mt. Park Land Co. core test No. 1.....	Union	Mt. Park.....	787.9L
329	Samuel Holt Heirs No. 1....	Springhill (Pa.)	———	895B
330	Chess Bros. No. 1.....	Union	South Penn	1250B
330A	Ley No. 1.....	Union	———	870B
331	Madeira Hotel water well...	Morgan	Madeira Bros.	868L
332	Snyder No. 1.....	Morgan	———	808L
332A	Ed. Wells No. 1.....	Morgan	———	1039L
333	Amer. Sheet & Tin Plate Co. No. 3.....	Morgan	Tin Plate	841L
334	Amer. Sheet & Tin Plate Co. No. 5.....	Morgan	Tin Plate	875L
335	Amer. Sheet & Tin Plate Co. No. 2.....	Morgan	Tin Plate	934L
336	Amer. Sheet & Tin Plate Co. No. 4.....	Morgan	Tin Plate	906L
337	Gamble coal test.....	Morgan	S. B. Elkins	880L
338	Hagedorn & Sons No. 1.....	Morgan	Bradley et al.	....
339	Maiden Spring Run well....	Morgan	Bradley et al.	....
340	Edmund Shisler No. 1.....	Morgan	Kuntz, Jr., & Co.	....
341	F. M. Johnson No. 1.....	Clinton	———	835B
342	Furnace tract No. 1.....	Clinton	———	1135B
342A	Minor Tennant No. 1.....	Clinton	Hope	....
343	Wm. E. Watson No. 1.....	Clinton	———	1100B
344	Rose Watson No. 1907.....	Clinton	Phila	970B

Wells in Monongalia County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	323
.....	.....	1100	.....	.....	2077	2120	2607	Dry hole	324
.....	.....	.....	.....	.....	.....	.....	.....	Gas show, light	325
.....	.....	.....	.....	.....	.....	.....	2504	B. I. gas and oil show..	326
.....	.....	.....	.....	.....	.....	.....	600	Salt, oil show	327
.....	.....	.....	.....	.....	.....	.....	100.3	———	328
.....	.....	.....	.....	.....	.....	.....	500	Salt, light gas	329
.....	.....	.....	.....	.....	.....	.....	2200	Dry hole	330
.....	.....	270	.....	.....	.....	.....	970	Dry hole	330A
.....	.....	.....	.....	.....	.....	.....	620	Water well	331
.....	.....	910	.....	.....	.....	.....	2267½	B. I. and Berea gas ...	332
.....	.....	.....	.....	.....	.....	.....	800	Dry hole	332A
.....	.....	.....	.....	.....	.....	.....	371	———	333
.....	.....	.....	.....	.....	.....	.....	427¼	———	334
.....	.....	.....	.....	.....	.....	.....	327¾	———	335
.....	.....	.....	.....	.....	.....	.....	402⅓	———	336
.....	.....	.....	.....	.....	.....	.....	403.2	———	337
.....	.....	.....	.....	.....	.....	.....	700-800	B. I. gas?.....	338
.....	.....	.....	.....	.....	.....	.....	700-800	Dry hole	339
.....	.....	890	.....	.....	.....	.....	2400	Dry hole	340
.....	.....	850	.....	1496	.....	.....	2280	Dry hole	341
.....	.....	.....	.....	.....	.....	.....	300	Dry hole	342
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	342A
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	343
.....	.....	905	.....	.....	.....	2046	2413	6th gas. light.....	344

In the elevation column the letter "B" indicates that the elevation of the well mouth was obtained with aneroid checked with nearby U. S. G. Survey spirit level elevations; the letter "L", with spirit level, the same being expressed in feet above tide. Depths to the Pittsburgh coal and the several sands are also expressed in feet.

Under the column headed "Producing Sand," the following abbreviations are used:

I. C. R.	First Cow Run.
B. Dunk	Big Dunkard.
Gas Ss.	Gas Sand.
II C. R.	Second Cow Run.
Max.	Maxton.
Knr.	Keener.
Big I.	Big Injun.
Berea	Berea Grit.
Gnz.	Gantz.
50-ft.	Fifty-foot.
30-ft.	Thirty-foot.
Stray	Gordon Stray.
Gord.	Gordon.
4th.	Fourth.
5th.	Fifth or McDonald.
6th.	Sixth or Bayard.
Eliz.	Elizabeth.

The accompanying table furnishes a means of ready reference as to the ownership and elevation of the several wells, along with the depth and thickness of the Pittsburgh coal, the depth to five important oil and gas horizons, and the name of the producing sands at most of the wells, but it is essential that the complete logs of a number of these borings be published, not only to preserve them from loss, but for the fund of information they contain as to other sands, as well as the presence or absence of minable coals. The accurate location of any tabluated well is readily determined from its serial or map number, published in the above table, on Map II and with the heading in parenthesis when the complete record is given.

Oil or gas in paying quantities have been produced in every district of Monongalia county west of the Monongahela river, but on the east side of the latter stream only one small paying gas well, located at Van Voorhis, has yet been found. The logs of a number of these wells along with a discussion of the several oil and gas fields and their relation to geologic structures will now be given by magisterial districts. The names of the sands and other formations inserted in parenthesis are corrections by the writer.

Battelle District.

Battelle district occupies the western end of Monongalia county, and adjoins Greene county, Pa., and Wetzel and Marion counties, W. Va. A glance at the structure contours on Map II will show that it is traversed in a northeast-southwest direction by three folds; viz., the Robinson and Waynesburg synclines, and the Amity anticline; and that its strata are very much warped, giving ideal conditions for the oil and gas pools found therein. In the northwestern corner of the district is found a pool of 8 oil wells in the Fourth sand along the axis of the Robinson Basin, being an extension to the northeast of the Hixenbaugh field of Wetzel county. This pool conforms ideally to the anticlinal theory as developed by I. C. White[4] in regard to the influence of structure on the seg-

4. Vol. I(a), W. Va. Geol. Survey, pp. 54-59; 1904.

regation of oil and gas into commercial pools, since this sand like all others below the Big Injun in this portion of the State is non-water bearing, thus permitting the oil which is heavier than gas to drop down along its horizon into the low portion of the trough. The same applies roughly to the great oil pools along the eastern border of Battelle at Bula, Crossroads and St. Leo.

On entering the district from Greene county, near Hero, the axis of the Amity anticline dips rapidly southward to the intersection of the axes of the Robinson and Waynesburg synclines, but along or near its crest there occur 25 to 30 gas wells. In the southeastern corner of the district there occurs another large oil pool in the Big Injun, Fourth and Bayard sands.

Taking up the Fourth sand pool first mentioned, the following record of a well from this locality gives the oil horizon and other data of interest:

John E. Snyder No. 1 Well Record (1).

Battelle district, 1.2 miles N 30° W of St. Cloud. Authority Cochran & Funk. Completed May 20, 1908.

(Elevation, 1425' B.A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1095	1095
Mapletown (Sewickley) coal	5	1100
Unrecorded	100	1200
Pittsburgh coal	9	1209
Unrecorded	391	1600
Little Dunkard sand	40	1640
Unrecorded	43	1683
Big Dunkard sand	92	1775
Unrecorded	110	1885
Gas sand	55	1940
Unrecorded	15	1955
Salt sand	260	2215
Unrecorded	120	2335
Maxton sand	40	2375
Unrecorded	10	2385
Big Lime	65	2450
Big Injun sand (gas, 2540'-2550')	240	2690
Unrecorded	120	2810
Thirty-foot sand	235	3045
Unrecorded	105	3150
Fifty-foot sand	80	3230
Unrecorded	20	3250
Gordon Stray sand	28	3278
Unrecorded	60	3338
Sand, (Fourth) (gas, 3381'; oil, 3382') and unrecorded to bottom	52	3390

The Pittsburgh coal—Fourth sand interval is slightly less here than in the St. Leo region, owing to the northwestward thinning of the intervening strata. The log of the Sarah E. Anderson No. 1 well, published in connection with the Burton (Wetzel county) section on pages 110-113 of the Marshall-Wetzel-Tyler Report of the State Survey, exhibits the true correlation of the Gordon group of sands for this region.

The following is the record of a dry hole drilled 0.3 mile northward just across the State line in Pennsylvania. It illustrates the patchy nature characteristic of the Fourth sand along this synclinal basin both northeastward in Pennsylvania and southwestward in Wetzel county, since the latter is dry while a very small showing of oil occurs in the Gordon:

Barnett Renner No. 1 Well Record (2).

Springhill Township, Greene county Pa., 0.9 mile southeast of Garrison. Authority, S. W. Meals.

(Elevation, 1175'B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	951	951
Pittsburgh coal	7	958
Unrecorded	393	1351
Little Dunkard sand	35	1386
Unrecorded	367	1753
Salt sand	107	1860
Unrecorded	216	2076
Maxton sand	40	2116
Unrecorded	11	2127
Big Lime	77	2204
Big Injun sand	213	2417
Unrecorded	334	2751
Sands, Gantz and Fifty-foot	67	2818
Unrecorded	75	2893
Thirty-foot sand	25	2918
Unrecorded	57	2975
Gordon Stray sand	25	3000
Unrecorded	27	3027
Gordon sand (very small oil show, 3043')	25	3052
Unrecorded	23	3075
Fourth sand	80	3155
Unrecorded	18	3173
Fifth sand	17	3190
Unrecorded to bottom	18	3208

"A real dry one, no oil or gas in any sand, except the small show above mentioned in the Gordon sand."

The following is the record of a well in the Fourth sand oil pool:

Barney Renner No. 2165 Well Record (37).

Battelle district, 0.3 mile southwest of St. Cloud. Authority, Philadelphia Company.

(Elevation, 1365' L.A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1044	1044
Mapletown (Sewickley) coal, and unrecorded	107	1151
Pittsburgh coal and unrecorded	1175	2326
Big Lime	95	2421
Big Injun sand	224	2645
Unrecorded	545	3190
Sand, (Gordon) (gas, 3195')	66	3256
Unrecorded	29	3285
Sand, (Fourth) (oil, 3325')	43	3328
Unrecorded to bottom	3	3331

The **Eli White No. 1 well (5)**, located about half way up the western slope of the Amity anticline, 1.6 miles northeast of St. Cloud, and drilled during 1889 and 1890, was probably the first deep well to be bored in the district. A strong flow of gas was encountered at 88 feet in the Big Injun sand, and also in the Gantz. The boring attained a depth of only 2090 feet below the Pittsburgh coal; hence, did not quite reach the Fourth sand. At that time a gas well in this region was considered the same as a dry hole, so it was plugged, the casing partly pulled and the well abandoned.

The **Kinsey Renner Heirs No 1 well (3)**, located just across the State line in the edge of Springhill township, 1.5 miles due north of St. Cloud, was drilled to a depth of 3084 feet below the top of the Pittsburgh coal without getting either oil or gas in paying quantities. A showing of gas was encountered in the Big Injun and in a sand shell—probably the Seventh or Elizabeth sand—at a depth of 2430'—2529' below the top of the Pittsburgh coal. A 3 to 4 bbl. showing of oil occurred in the Fourth sand at a depth of 3085 feet.

The log of the **Jas. L. White No. 1 well (7)**, 1 mile northeast of St. Cloud, is published in connection with the St. Cloud section, page 92.

In addition to the brief logs as given in the table of wells for Monongalia county, the much more complete records of the following in Battelle district except No. 18 are published

on the pages indicated of Vol. I(A) and Vol. I of the State Survey reports:

Map No.	Name of Well.	Location	Page. Vol.1(A)
4	S. L. S. Spragg No. 1.....	0.5 mile N. E. of St. Cloud	150
16	William Porter No. 1.....	1.7 mile N. W. of Wise	149
18	Jacob Simpson No. 1.....	0.1 mile E. of Jollytown.	126
24	James Hagan No. 1.....	0.7 mile S. W. of Wise..	149
34	R. S. Clovis No. 1.....	1.6 mile N. W. of Wadestown	143
54	Haught Heirs No. 1.....	0.6 mile N. W. of St. Leo	148
66	Rufus Bell No. 1.....	0.8 mile S. E. of Wise...	143
68	Rufus Bell No. 2.....	1 mile S. E. of Wise..	144
70	Milo Strosnider No. 1.....	1 mile S. E. of Wise..	144
79	Sarah E. Eddy No. 1.....	0.4 mile N. W. of Crossroads	143
91	Ewing Heirs No. 1.....	2.1 mile S., 10° E. of Wadestown	145
102	J. M. Hall No. 1.....	0.1 mile S. W. of St. Leo	147
110	Anna Harvey No. 1.....	1.7 mile N., 70° E. of Galletin	137
31	Alonzo Edwards No. 1.....	0.5 mile N. E. of Wadestown	Vol. I. 230
90	Samuel Eakin No. 1.....	2.1 miles S., 10° E. of Wadestown	232

No. 4 had a gas show in the Big Injun and an oil show in Fourth. wrongly named Gordon, but was abandoned as dry hole.

No. 16 had gas show in Bayard, but was abandoned as dry hole

No. 18 was a heavy gasser in Big Injun with rock pressure of 700 pounds.

No. 24 was a light gasser in Gantz, but abandoned as non-paying well.

No. 34, light gas in Big Injun; drilled to 2622′ below Pittsburgh coal; no Bayard or Elizabeth; abandoned as dry hole.

No. 54 had oil shows in Fifty-foot and Bayard, but abandoned as dry hole.

No. 66 was a Fourth sand oil producer.

No. 68 was a Fourth said oil producer.

No. 79 had gas show in Big Injun, was a heavy gasser in Gordon and had an initial production of 360 bbls. of oil daily from Fourth sand.

No. 91 was a heavy gasser in Gantz and a good Gordon oil producer.

No. 102 was a fair Gordon oil producer.

No. 110 was a 2200 bbl. daily oil producer from the Fourth sand.

No. 31 was a gasser, Big Injun, Gantz, Fifty-foot and Fifth.

No. 90 was a strong gasser in Gantz and a fair oil producer in Gordon.

The following records of gas wells scattered along the crest and western slope of the Amity anticline give valuable

data as to the coals, gas horizons, volume and rock pressure of the borings. The principal gas horizons are the Big Injun, Fifty-foot, Thirty-foot, Gordon, Fourth and Fifth sands.

Fred H. Hennen No. 1 Well Record (6).

Battelle district, 1 mile northwest of Maple. Authority, Carnegie Natural Gas Co. Completed Nov. 28, 1906.

(Elevation, 1110′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	855	855
Pittsburgh coal and unrecorded	1260	2115
Big Injun sand	285	2400
Unrecorded	420	2820
Sand, Fifty-foot (Little Gas, 2823′)	28	2848
Unrecorded	30	2878
Sand, Thirty-foot (gas, 2891′)	25	2903
Unrecorded	6	2909
Gordon Stray	25	2934
Unrecorded	40	2974
Sand, Gordon (little gas, 2975′)	26	3000
Unrecorded	25	3025
Fourth sand	50	3075
Unrecorded	34	3109
Fifth sand	21	3130
Unrecorded	25	3155
Sand	15	3170
Unrecorded to bottom	41	3211

10″ casing, 130′; 8¼″ casing, 1295″; 6⅝″ casing, 2070′; and 4″ tubing, 2159′.

This well is still producing gas in February, 1913.

John G. White No. 1 Well Record (8).

Battelle district, 0.7 mile west of Maple. Authority, Carnegie Natural Gas Company. Completed April 8, 1910.

(Elevation, 1150′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	540	540
Waynesburg coal	5	545
Unrecorded	235	780
Mapletown coal	4	784
Unrecorded	96	880
Pittsburgh coal	8	888
Unrecorded	1293	2181
Big Injun sand (gas 2259′)	225	2406
Unrecorded	602	3008
Gordon Stray sand	15	3023
Unrecorded	32	3055
Gordon sand	62	3117
Unrecorded	33	3150
Fourth sand	14	3164

	Thickness. Feet.	Total. Feet.
Unrecorded	17	3181
Fifth sand	45	3226
Unrecorded to bottom	82	3308

Abandoned as dry hole.

Simon L. White No. 1 Well Record (9).

Battelle district, at Maple. Authority, Philadelphia Company.

(Elevation, 1130′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	755	755
Mapletown (Sewickley) coal, and unrecorded	90	845
Pittsburgh coal and unrecorded	770	1615
Salt sand	207	1822
Unrecorded	309	2131
Big Injun sand	239	2370
Unrecorded	650	3020
Sand, (Gordon)	40	3060
Unrecorded	20	3080
Sand, (Fourth)	36	3116
Unrecorded	20	3136
Sand, (Fifth) (gas pay, 3145′-3147′)	27	3163

This well did not make sufficient gas to justify connection with the company's pipe line.

Thomas White No. 1 Well Record (10).

Battelle district, 0.4 mile northeast of Maple. Authority, Manufacturers Light & Heat Company. Completed January 14, 1905.

(Elevation, 1065′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	438	450
Waynesburg coal	6	456
Unrecorded	238	694
Mapletown (Sewickley) coal	5	699
Unrecorded	86	785
Pittsburgh coal	8	793
Unrecorded	232	1025
Murphy sand	20	1045
Unrecorded	165	1200
Little Dunkard sand	30	1230
Unrecorded	80	1310
Big Dunkard sand	35	1345
Unrecorded	95	1440
(Gas sand)	120	1560
Unrecorded	30	1590
Sand, (II Cow Run)	50	1640
Unrecorded	25	1665
Salt sand (water, 1676′)	155	1820
Unrecorded	150	1970

	Thickness. Feet.	Total. Feet.
Pencil cave	5	1975
Big Lime	75	2050
Big Injun sand (gas, 2060′ and 2078′ and unrecorded to bottom	190	2240

13″ casing, 57′; 10″ casing, 1181′; 8¼″ casing, 1744′; 6⅝″ casing, 1995′.

"First minute pressure in 4″ tubing, 138 lbs.; rock pressure, 700 lbs."

The well starts flush with the crop of the Dunkard coal, and is still making gas in paying quantity from the Big Injun.

J. P. Hagan No. 2 Well Record (12).

Gilmore township, Greene county, Pa., 0.9 mile west of Hero. Authority, Porter Daubenspeck, a driller on well.

(Elevation, 1095′ B-A. T.)	Thickness. Feet.	Total. Feet.
Clay	15	15
Lime, white and hard (water, 50′)	155	170
Red rock	35	205
Slate and lime, white and broken	75	280
Lime, white and hard	30	310
Slate, dark, soft	30	340
Lime, white and hard	25	365
Slate, white and soft	15	380
Lime, white and hard	75	455
Sand, white and hard, Waynesburg	25	480
Coal, Waynesburg	3	483
Slate, white	57	540
Sand, white	15	555
Slate, dark	60	615
Lime, white and hard	97	712
Coal, Mapletown (Sewickley)	4	716
Lime, dark, hard	84	800
Slate, soft	5	805
Coal, Pittsburgh	8	813
Slate, dark	25	838
Sand, dark	7	845
Slate	30	875
Lime, white and hard	25	900
Red rock	5	905
Slate	45	950
Red rock	20	970
Sand, (Minshall)	20	990
Red rock	45	1035
Slate	35	1070
Red rock	50	1120
Slate	20	1140
Lime	20	1160
Slate	37	1197
Sand, hard, Little Dunkard	70	1267
Slate	38	1305

	Thickness. Feet.	Total. Feet.
Lime	26	1331
Sand, white and hard, Big Dunkard	79	1410
Slate, dark	10	1420
Sand, white, hard	10	1430
Slate	25	1455
Gas sand, white and hard	125	1580
Slate, black	25	1605
Sand (II Cow Run and Salt) (water, 1710′)	130	1735
Lime, dark	10	1745
Slate, dark	90	1835
Sand, white and hard	10	1845
Slate	15	1860
Red rock	120	1980
Lime, white and hard	10	1990
Slate	25	2015
Sand, white and hard	8	2023
Slate	7	2030
Big Lime (Greenbrier Limestone)	60	2090
Big Injun sand, white and hard, (gas, 2165′)	260	2350
Slate	30	2380
Lime	25	2405
Sand, dark and hard (Squaw)	30	2435
Slate and shells	225	2660
Sand, white and hard (Berea)	25	2685
Slate, shelly	110	2795
Fifty-foot sand (gas, 2811′)	28	2823
Slate	8	2831
Sand, hard and white	16	2847
Slate	5	2852
Sand, white and hard (Thirty-foot)	60	2912
Red rock	3	2915
Slate and shells, white and close	45	2960
Stray sand, white and hard	20	2980
Slate, shelly	25	3005
Gordon sand		

10″ casing, 347′ 6″; 8¼″ casing, 1206′ 8″; 6⅝″ casing, 1743′; 5″ casing, 2142′ 3″.

This well was abandoned on account of fishing job and a new hole drilled nearby which proved dry.

J. P. Hagan No. 1 Well Record (13).

Gilmore township, Greene county, Pa., 0.6 mile west of Hero. Authority, Philadelphia Company. Completed Aug. 15, 1905.

(Elevation, 1040′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	642	642
Mapletown (Sewickley) coal and unrecorded	98	740
Pittsburgh coal	7	747
Unrecorded	1274	2021
Big Injun sand (gas, 2102′)	271	2292
Unrecorded	533	2825

	Thickness. Feet.	Total. Feet.
Sand, (Stray)	25	2850
Unrecorded	100	2950
Fourth sand	30	2980
Unrecorded	78	3058
Fifth sand (gas, 3058')	32	3090
Unrecorded	45	3135
Bayard sand	10	3145
Unrecorded to bottom	198	3343

First pressure test in 5⅜" casing:

2nd minute, 2½ lbs.
5th minute, 15 lbs.
10th minute, 35 lbs.
20th minute, 65 lbs.
30th minute, 95lbs.
45th minute, 135 lbs.
Rock pressure in 3 hours, 600 lbs.

The last two wells are a few hundred feet over the State line in the edge of Pennsylvania, the latter starting 9 feet above the Jollytown coal which crops here in the bed of Dunkard creek.

Elijah C. Clovis No. 1 Well Record (35).

Battelle district, 1.1 miles east of St. Cloud. Authority, Manufacturers Light & Heat Company. Completed July 29, 1905.

(Elevation, 1165' B.A. T.)	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	573	585
Waynesburg coal	3	588
Unrecorded	237	825
Mapletown (Sewickley) coal	7	832
Unrecorded	88	920
Pittsburgh coal	8	928
Unrecorded	152	1080
Sand (Minshall)	10	1090
Unrecorded	170	1260
Sand	10	1270
Unrecorded	40	1310
Sand	50	1360
Unrecorded	40	1400
Big Dunkard sand (gas, 1400')	40	1440
Unrecorded	145	1585
Gas sand	100	1685
Unrecorded	45	1730
Salt sand (water, 1835'; break, 1850'-1880')	160	1890
Unrecorded	120	2010
Maxton sand	25	2035
Red rock	20	2055
Unrecorded	75	2130
Big Lime (very hard)	78	2208
Big Injun sand (gas, 2219')	238	2446
Unrecorded	429	2875
Fifty-foot sand (gas 2878') to bottom	61	2936

10" casing, 400'; 8¼" casing, 1354'; 6⅝" casing, 1912'.

"Pressure test in 4" tubing; first minute, 110 lbs.; rock pressure, 680 lbs.

The above well is still producing gas in the pipe lines.

Nancy Hostutler No. 1 Well Record (38).

Battelle district, 0.7 mile southeast of St. Cloud. Authority, Manufacturers Light & Heat Company. Completed Nov. 8. 1905.

(Elevation, 1200′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	13	13
Unrecorded	452	465
Sand	65	530
Unrecorded	115	645
Waynesburg coal	5	650
Unrecorded	100	750
Sand	40	790
Lime	90	880
Unrecorded	10	890
Mapletown (Sewickley) coal	5	895
Unrecorded	100	995
Pittsburgh coal	5	1000
Unrecorded	340	1340
Little Dunkard sand	15	1355
Unrecorded	155	1500
Big Dunkard sand	80	1580
Unrecorded	100	1680
Gas sand	60	1740
Unrecorded	25	1765
Sand (II Cow Run)	35	1800
Unrecorded	15	1815
Salt sand (no water)	90	1905
Unrecorded	145	2050
Red rock	45	2095
Maxton sand	45	2140
Unrecorded	45	2195
Pencil cave	10	2205
Big Lime	63	2268
Big Injun sand	223	2491
Unrecorded	319	2810
Sand (Berea)	25	2835
Unrecorded	109	2944
Gantz sand	10	2954
Unrecorded	16	2970
Fifty-foot sand (little gas, 3046′)	87	3057
Unrecorded	83	3140
Gordon sand	47	3187
Unrecorded	37	3224
Fourth sand	10	3234
Unrecorded	31	3265
Fifth sand	15	3280
Unrecorded	180	3420
Bayard sand	3	3423
Unrecorded to bottom	164	3587

10″ casing, 481′; 8¼″ casing, 1418′; 6⅝″ casing, 2223′.

The above well reached a depth of 2587 below the Pittsburgh coal and reports no Elizabeth sand, the same being true of the following well which penetrated the strata to a depth of 2582 feet below the Pittsburgh coal.

Nancy Johnson No. 1 Well Record (40).

Battelle district, 1.1 miles southeast of St. Cloud. Authority, Manufacturers Light & Heat Company. Completed Feb. 10, 1907.

(Elevation, 1095′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	756	756
Mapletown (Sewickley) coal	4	760
Unrecorded	107	867
Pittsburgh coal	5	872
Unrecorded	390	1262
Little Dunkard sand	60	1322
Unrecorded	68	1390
Big Dunkard sand	20	1410
Unrecorded	131	1541
Gas sand	69	1610
Unrecorded	60	1670
Salt sand	80	1750
Unrecorded	225	1975
Maxton sand	30	2005
Unrecorded	52	2057
Big Lime	75	2132
Big Injun sand (water, 2257′)	228	2360
Unrecorded	444	2804
Fifty-foot sand (gas, 2814′)	44	2848
Unrecorded	10	2858
Sand, Thirty-foot	22	2880
Unrecorded	29	2909
Gordon Stray sand	21	2930
Unrecorded	25	2955
Gordon sand	30	2985
Unrecorded	30	3015
Fourth sand	40	3055
Unrecorded	20	3075
Fifth sand	25	3100
Unrecorded to bottom (no Bayard sand)	354	3454

10″ casing, 261′; 8¼″ casing, 1265′; 6⅝″ casing, 2074′.

J. H. Six No. 1 Well Record (41).

Battelle district, 1.1 miles southeast of St. Cloud. Authority, Carnegie Natural Gas Company. Completed to 2955′, Sept. 21, 1906, and drilled to 3160′ Aug. 14, 1907.

(Elevation, 1110′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	885	885
Pittsburgh coal	8	893
Unrecorded	1242	2135
Big Injun sand	230	2365
Unrecorded	475	2840
Fifty-foot sand	54	2894
Unrecorded	18	2912
Gordon Stray sand	24	2936
Unrecorded	9	2945
Sand, Gordon, (gas, 2955′-2965′)	10	2955
Unrecorded	130	3085

	Thickness. Feet.	Total. Feet.
Fourth sand	12	3097
Unrecorded	48	3145
Fifth sand	10	3155
Unrecorded to bottom	5	3160

10″ casing, 130′; 8¼″ casing, 1330′; 6⅝″ casing, 2125′; 3″ tubing, 2965′.

Pressure test in 3″ tubing:

½ minute, 300 lbs.	4th minute, 400 lbs.
1st minute, 380 lbs.	5th minute, 410 lbs.
2nd minute, 390 lbs.	6th minute, 500 lbs.

Lewis Lemley No. 1 Well Record (43).

Battelle district, 1.5 miles S 10° E of St. Cloud. Authority Fisher Oil Company. Completed July 19, 1904.

	Thickness. Feet.	Total. Feet.
Unrecorded	1157	1157
Pittsburgh coal and unrecorded	963	2120
Salt sand	60	2180
Unrecorded	45	2225
Red rock	95	2320
Slate and lime	50	2370
Big Lime	66	2436
Big Injun sand (gas, 2501′) and unrecorded to bottom	70	2506

Conductor, 14′; 8¼″ casing, 1550′; 6⅝″ casing, 2384′.

Pressure test in 4″ tubing:

1st ½ minute, 260 lbs.	4th minute, 680 lbs.
1st minute, 380 lbs.	5th minute, 685 lbs.
1½ minute, 500 lbs.	10th minute, 695 lbs.
3rd minute, 635 lbs.	Rock pressure, 700 lbs.

An open flow test from 4″ vent with a diaphragm gage registered 12½ pounds, equivalent to 10,400,000 cubic feet of gas in 24 hours. The foregoing tests were made in the presence of the writer on Aug. 2, 1904. Although 8½ years old the above well is still producing gas in paying quantity.

Marion Henderson No. 2411 Well Record (44A).

Battelle district, 2.2 miles northwest of St. Leo. Authority, Philadelphia Company. Completed Nov. 22, 1911.

	Thickness. Feet.	Total. Feet.
Unrecorded	830	830
Mapletown (Sewickley) coal and unrecorded	90	920
Pittsburgh coal and unrecorded	1230	2150
Big Lime	70	2220
Big Injun sand	220	2440
Unrecorded	505	2945

	Thickness. Feet.	Total. Feet.
Sand (Thirty-foot) (gas, 2980')	52	2997
Unrecorded	88	3085
Gordon sand	17	3102
Unrecorded	100	3202
Fifth sand	18	3220

First pressure test in 6⅝" casing:

5th minute, 8 lbs.
10th minute, 15 lbs.
15th minute, 30 lbs.
13th minute, 65 lbs.
Rock pressure in 2 hours, 235 lbs.

"Shot Nov. 28, 1911, and increased about one-half."

Abe W. Whisler No. 2407 Well Record (45).

Battelle district, 1.4 miles northeast of Cottontown. Authority, Philadelphia Company. Completed July 29, 1911.

(Elevation, 1170' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1015	1015
Pittsburgh coal and unrecorded	1190	2205
Big Lime	80	2285
Big Injun sand	215	2505
Unrecorded	650	3155
Gordon Stray sand	15	3170
Unrecorded	3	3173
Gordon sand	22	3195
Unrecorded	13	3208
Fourth sand (gas, 3210'-3217')	19	3227
Unrecorded to bottom	55	3282

First pressure test in 6⅝" casing:

1st ½ minute, 10 lbs.
1st minute, 15 lbs.
2nd minute, 25 lbs.
5th minute, 60 lbs.
10th minute, 115 lbs.
15th minute, 155 lbs.
30th minute, 290 lbs.

"Shot Aug. 1, 1911, and increased one-half."

John M. Liming No. 2303 Well Record (48).

Battelle district, 1.9 miles east of Cottontown. Authority, Philadelphia Company. Completed Oct. 30, 1909.

(Elevation, 1130' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	946	946
Pittsburgh coal and unrecorded	1276	2222
Big Injun sand (gas, 2287'-2302') and unrecorded to bottom	97	2319

First pressure test in 4" tubing:

1st ½ minute, 110 lbs.
1st minute, 175 lbs.
2nd minute, 275 lbs.
5th minute, 440 lbs.
10th minute, 550 lbs.
Rock pressure, 625 lbs.

Sol. S. Lemley No. 1 Well Record (49).

Battelle district, 1.8 miles northwest of St. Leo. Authority, Philadelphia Company.

(Elevation, 1170′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	995	995
Pittsburgh coal and unrecorded	480	1475
Sand, Dunkard	125	1600
Unrecorded	75	1675
Gas sand	70	1745
Unrecorded	180	1925
Salt sand	65	1990
Unrecorded	174	2164
Little lime	10	2174
Unrecorded	27	2203
Big Lime	64	2267
Big Injun sand	193	2460
Unrecorded	455	2915
Fifty-foot sand	15	2930
Unrecorded	81	3011
Thirty-foot sand (gas, 3036′; oil show)	35	3046
Unrecorded	109	3155
Sand, (Gordon)	10	3165
Unrecorded	27	3192
Sand, (Fourth)	23	3215
Unrecorded	25	3240
Sand, (Fifth)	17	3257
Unrecorded	129	3386
Sand, (Bayard) (shell) and unrecorded to bottom	62	3458

The above well was abandoned on completion as a dry hole.

Amy Maple No. 1 Well Record (50).

Battelle district, 1.7 miles northwest of St. Leo. Authority, Manufacturers Light & Heat Company.

	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	898	910
Mapletown (Sewickley) coal	...	910
Unrecorded	95	1005
Pittsburgh coal	...	1005
Unrecorded	510	1515
Big Dunkard sand	75	1590
Unrecorded	44	1634
Gas sand	123	1757
Unrecorded	65	1822
First Salt sand	40	1862
Unrecorded	8	1950
Second Salt sand	70	2020

	Thickness. Feet.	Total. Feet.
Unrecorded (red rock at 2195')	200	2220
Big Lime	83	2303
Big Injun sand	195	2498
Unrecorded	452	2950
Fifty-foot sand	40	2990
Unrecorded	10	3000
Thirty-foot sand	34	3034
Unrecorded	4	3038
Sand, (Thirty-foot) (gas, 3049')	20	3058
Unrecorded	13	3071
Sand, (Stray)	26	3097
Unrecorded	33	3130
Sand, (Gordon)	55	3185
Unrecorded	40	3225
Sand, (Fourth)	5	3230
Unrecorded to bottom	78	3308

10" casing, 270'; 8¼" casing, 1515'; 6⅝" casing, 2274'; 4" tubing, 3049'.

Pressure test in 4" tubing:
1st minute, 35 lbs.; rock pressure, 950 lbs.

The Fred O. Liming Well (51), located on Middle fork, 2 miles southwest of Wadestown, and completed Oct. 30, 1909, had a small gas show at a depth of 3470 feet, 2400 feet below the Pittsburgh coal, in "shells" that appear to represent the Bayard sand. The well was abandoned as nonproductive.

The following is the record of a well located only 0.3 mile northeastward, in which gas pays were encountered in three different sands; viz., Big Injun, Thirty-foot and Gordon:

Sol M. Shriver No. 2306 Well Record (52).

Battelle district, 1.7 miles southwest of Wadestown. Authority, Philadelphia Company. Completed Oct. 30, 1909.

(Elevation, 1130' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	935	935
Pittsburgh coal	...	935
Unrecorded	1290	2225
Big Injun sand (gas, 2239')	187	2412
Unrecorded	363	2775
Sand, (Berea)	10	2785
Unrecorded (30-ft. gas at 2937')	210	2995
Gordon Stray sand (gas, 3005')	39	3034
Unrecorded	41	3075
Sand (Gordon)	15	3090
Unrecorded to bottom	5	3095

Pressure test in 3" tubing:

1st ½ minute, 50 lbs.	5th minute, 220 lbs.
1st minute, 90 lbs.	10th minute, 350 lbs.
2nd minute, 125 lbs.	Rock pressure, 805 lbs.

The following is the record of a deep well more than two-thirds down the eastern slope of the Amity anticline, near the axis of the Waynesburg Basin. As should be expected in this trough, the Big Injun is water bearing. Light gas shows were encountered in the Fifth and Bayard sands, but the well was abandoned as non-productive. Four coals are recorded above the top of the Conemaugh series, all apparently of minable thickness:

John Estel Heirs No. 1 Well Record (53).

Battelle district, 1 mile N 15° E of St. Leo. Authority, Manufacturers Light & Heat Company. Completed Aug. 17, 1910.

	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	796	810
Native (Washington) coal	3	813
Unrecorded	132	945
Fairview (Waynesburg) coal	4	949
Unrecorded	293	1242
Mapletown (Sewickley) coal	6	1248
Unrecorded	94	1342
Pittsburgh coal	8	1350
Unrecorded	390	1740
Little Dunkard sand	25	1765
Unrecorded	81	1846
Big Dunkard sand	44	1890
Unrecorded	90	1980
Gas sand	85	2065
Unrecorded	200	2265
Salt sand	65	2330
Unrecorded	207	2537
Little Lime	17	2554
Pencil cave	5	2559
Big Lime	72	2631
Big Injun sand (water 2711')	165	2796
Unrecorded	473	3269
Sand, (Gantz and Fifty-foot)	78	3347
Unrecorded	11	3358
Thirty-foot sand	22	3380
Unrecorded	10	3390
Shell	10	3400
Red rock	10	3410
Sand, (Stray)	22	3432
Unrecorded	4	3436
Gordon sand	6	3442
Unrecorded	18	3460
Sand, (Gordon)	55	3515
Unrecorded	11	3526
Sand, (Fourth)	29	3555
Unrecorded	35	3590
Fifth sand (gas, 3597')	30	3620

	Thickness. Feet.	Total. Feet.
Unrecorded	2	3622
Sand	4	3626
Unrecorded	34	3660
Sand	9	3669
Unrecorded	64	3733
Bayard sand (little gas)	3	3736
Unrecorded to bottom	9	3745

10" casing, 269'; 8¼" casing, 1856'; 6⅝" casing, 2579'; 5⅛" casing, 2754'.

On the waters of Pumpkin run in the northern edge of Battelle district some heavy gas wells occur in the Big Injun sand along the eastern slope of the Waynesburg syncline. The presence of good gas wells in a synclinal basin is not unusual in a rising syncline, and an examination of Map II will show that this region occupies a relatively high structure level, since the Pittsburgh coal rises rapidly northeastward to the State line along the axis of the latter trough from the vicinity of St. Leo. The four following records from this field give valuable pressure tests and other data of interest:

John Lantz No. 2562 Well Record (19).

Gilmore township, Greene county, Pa., 1.2 miles southeast of Jollytown. Authority, Philadelphia Company. Completed Nov. 26, 1910.

(Elevation, 990' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	710	710
Pittsburgh coal	...	710
Unrecorded	1265	1975
Big Injun sand (gas, 1981') and unrecorded to bottom	28	2003

First pressure test in 6⅝" casing:

1st ½ minute, 50 lbs.	10th minute, 370 lbs.
1st minute, 80 lbs.	15th minute, 430 lbs.
2nd minute, 135 lbs.	30th minute, 505 lbs.
5th minute, 280 lbs.	Rock pressure in 2½ hours, 595 lbs.

T. W. Kinnan No. 1 Well Record (20).

Battelle district, 1 mile southeast of Jollytown. Authority, Charles Shough. Completed Sept. 9, 1911.

(Elevation, 1060 B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	18	18
Unrecorded (water, 138 feet, 5 bailers)	262	280
Coal, Crabapple? (Washington "A") and unrecorded	140	420
Pluff sand (water, 430', 4 bailers) and unrecorded	20	440
Waynesburg coal and unrecorded	255	695

	Thickness. Feet.	Total. Feet.
Mapletown (Sewickley) coal	6	701
Unrecorded	79	780
Pittsburgh coal (4 bailers water)	8	788
Unrecorded	157	945
Murphy sand	70	1015
Black slate	15	1030
Red rock	55	1085
Sand, (Saltsburg)	55	1140
Unrecorded	40	1180
Red rock	5	1185
Little Dunkard sand	53	1238
Black streak	2	1240
Big Dunkard sand	85	1325
Black streak (Upper Freeport coal horizon)	2	1327
Lime	105	1432
Coal streak (Upper Kittanning)	2	1434
Black slate	21	1455
Gas sand	95	1550
Slate	15	1565
Lime	7	1572
Slate	4	1576
Sand (II Cow Run)	44	1620
Lime	20	1640
Slate	15	1655
Salt sand (water 1730', 2 bailers)	160	1815
Black slate	15	1830
Red rock	95	1925
Lime	30	1955
Red rock	5	1960
Black slate	2	1962
Little Lime	10	1972
Pencil cave	8	1980
Big Lime	79	2059
Big Injun sand (steel line measurement) (gas, 2067'-2078') to bottom	40½	2099½

13" casing, 155'; 10" casing, 1080' (settled 8'); 8" casing, 1680'; 6⅝" casing, 2014½'.

"Gas shut in on 6⅝" casing."

Through J. P. Hagan of Hero, Pa., and Kelley Bros., the contractors, samples of both the Sewickley and Pittsburgh coal beds were obtained from this well for analysis, the composition, calorific value and fuel ratio of which are given in the table of coal analyses.

Elza Wade No. 2348 Well Record (21).

Battelle district, 1.3 miles northwest of Wise. Authority, Philadelphia Company. Completed Aug. 20, 1910.

(Elevation, 1020' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	750	750
Pittsburgh coal	...	750

	Thickness. Feet.	Total. Feet.
Unrecorded	1225	1975
Big Lime	58	2033
Big Injun sand (gas, 2058') and unrecorded to bottom	162	2195

First pressure test in 6⅝" casing:

1st ½ minute, 19 lbs.	5th minute, 144 lbs.
1st minute, 36 lbs.	10th minute, 232 lbs.
2nd minute, 68 lbs.	

This well was drilled on down through the Fifth sand during 1912 without getting any additional gas or any oil.

Minerva Hennen No. 1 Well Record (23).

Battelle district, 0.4 mile N 20° E of Wise. Authority, Hope Natural Gas Company. Completed June 12, 1907.

(Elevation, 1050' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	667	667
Coal, Mapletown (Sewickley)	3	670
Unrecorded	78	748
Coal, Pittsburgh	5	753
Unrecorded	392	1145
Little Dunkard sand	30	1175
Unrecorded	79	1254
Big Dunkard sand	68	1322
Unrecorded	128	1450
Gas sand	45	1495
Unrecorded	120	1615
Salt sand (water, 1625', 1660', 1705', 1725')	97	1812
Unrecorded	123	1935
Big Lime	89	2024
Big Injun sand (gas, 2032' and 2073')	236	2260
Unrecorded	425	2685
Fifty-foot sand	95	2770
Unrecorded	169	2939
Sand, (Gordon)	34	2973
Unrecorded	22	2995
Sand, (Fourth) (gas, 2951')	8	3003
Unrecorded	39	3042
Sand (Fifth) (gas, 3067') and unrecorded to bottom	33	3075

Pressure test in 5⅜" casing at end of

1st minute, 80 lbs.	10th minute, 205 lbs.
2nd minute, 130 lbs.	11th minute, 205 lbs.
3rd minute, 160 lbs.	12th minute, 205 lbs.
4th minute 180 lbs.	13th minute, 205 lbs.
5th minute, 190 lbs.	14th minute, 210 lbs.
6th minute, 195 lbs.	15th minute, 210 lbs.
7th minute, 200 lbs.	30th minute, 220 lbs.
8th minute, 200 lbs.	60th minute, 235 lbs.
9th minute, 200 lbs.	

"Volume, ⅛" mercury in 5⅜" opening."

The volume test is equivalent to 3,222,000 cubic feet of gas daily.

Two miles southward in Battelle from the Pumpkin Run—Big Injun gas field there occur several good gassers in the Gantz, Fifty-foot, Fourth and Fifth sands. The five following records give the gas horizons, pressure tests and coal data:

Mary A. Eakin No. 1 Well Record (26).

Battelle district, 1.2 miles northeast of Wadestown. Authority Philadelphia Company. Completed March 21, 1911.

(Elevation, 1005' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	684	684
Mapletown (Sewickley) coal and unrecorded	96	780
Pittsburgh coal	....	780
Unrecorded	1225	2005
Big Lime	57	2062
Big Injun sand	193	2255
Unrecorded	449	2704
Sand, (Gantz and Fifty-foot) (oil, 2717'; gas, 2730')	91	2795
Unrecorded	200	2995
Sand, (Fourth)	15	3010
Unrecorded	28	3038
Sand, (Fifth)	35	3073
Unrecorded to bottom	88	3161

Pressure in 6 5/8" casing:

1st ½ minute, 5 lbs.
5th minute, 8 lbs.
10th minute, 20 lbs.
15th minute, 40 lbs.
30th minute, 100 lbs.
Rock pressure, 200 lbs.

The drillers in this region have erroneously placed the Gordon at the horizon of the Fourth sand.

Sol Shriver No. 2 Well Record (27).

Battelle district, 1.4 miles northeast of Wadestown. Authority, Hope Natural Gas Co. Completed November 8, 1908.

(Elevation, 1015' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	259	275
Coal, native (Washington)	4	279
Unrecorded	502	781
Pittsburgh coal (steel line measurement)	8	789
Unrecorded	506	1295
Dunkard sand (steel line measurement)	35	1330
Unrecorded	130	1460
Gas sand (steel line measurement)	130	1590
Unrecorded	10	1600
Sand, (II Cow Run)	55	1655
Unrecorded	50	1705
Sand, Second salt (water, 1725'; steel line measurement)	85	1790
Unrecorded	105	1895
Maxton sand	20	1915

	Thickness. Feet.	Total. Feet.
Unrecorded	83	1998
Pencil cave	4	2002
Big Lime	54	2056
Unrecorded	2	2058
Big Injun sand (oil and water, 2151'-2171') (steel line measurement)	189	2247
Unrecorded	467	2714
Sand (Gantz and Fifty-foot) (gas, 2741') (steel line measurement)	91	2805
Unrecorded	181	2986
Gordon Stray sand	13	2997
Unrecorded	15	3012
Sand, (Fourth) (steel line measurement)	15	3027
Unrecorded	24	3051
Sand, (Fifth) (light gas, 3074') and unrecorded to bottom	24	3075

13" casing, 177'; 10" casing, 1117'; 8¼" casing, 1782'; 6⅝" casing, 2084'; 5 3/16" casing, 2197'.

Shot November 13, 1908, with 60 quarts; 30' shell; top of first, 2756'; top of second, 2741'.

George W. Shriver No. 1 Well Record (29).

Battelle district, 1.3 miles north of Wadestown. Authority, Philadelphia Company.

(Elevation, 1095' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	866	866
Pittsburgh coal	7	873
Unrecorded	1207	2080
Big Lime	80	2160
Big Injun sand	185	2345
Unrecorded	715	3060
Sand, (Gordon)	20	3080
Unrecorded	10	3090
Sand, (Fourth)	10	3100
Unrecorded	52	3152
Sand, (Fifth) (gas, 3155')	23	3175
Unrecorded to bottom	5	3180

First pressure test in 6 5/8" casing:

1st. ½ minute, 10 lbs.	10th minute, 150 lbs.
1st minute, 20 lbs.	15th minute, 195 lbs.
2nd minute, 35 lbs.	20th minute, 230 lbs.
5th minute, 85 lbs.	

L. H. and R. Wilson No 1 Well Record (32).

Battelle district, 0.4 miles southeast of Wadestown. Authority, South Penn Oil Company.

(Elevation, 1159' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	865	865
Coal, Mapletown, (Sewickley)	5	870
Unrecorded	100	970
Pittsburgh coal	10	980

	Thickness. Feet.	Total. Feet.
Unrecorded	1255	2235
Big Injun sand (gas, 2293')	165	2400
Unrecorded	505	2905
Fifty-foot sand (gas, 2910')	65	2970
Unrecorded	240	3210
Fourth sand (gas, 3212'; oil, 3218'; oil show, 3225')	35	3245
Unrecorded to bottom	220	3465

This well sprays some oil, probably from the Fourth sand pay at 3218'.

E. B. Bell No. 2239 Well Record (33).

Battelle district, 0.4 miles northwest of Wadestown. Authority, Philadelphia Company. Completed July 14, 1908.

	Thickness. Feet.	Total. Feet.
Unrecorded	765	765
Mapletown (Sewickley) coal and unrecorded	92	857
Pittsburgh coal	..	857
Unrecorded	1303	2160
Big Injun sand	170	2330
Unrecorded	304	2634
Thirty-foot sand	50	2684
Unrecorded	91	2775
Fifty-foot sand and unrecorded	80	2855
Unrecorded	235	3090
Fourth sand (gas, 3110') and unrecorded to bottom	177	3267

First pressure test in 3" tubing:

1st ½ minute, 15 lbs.
1st minute, 25 lbs.
2nd minute, 50 lbs.
5th minute, 105 lbs.
10th minute, 185 lbs.
30th minute, 300 lbs.
Rock pressure in 12 hours, 415 lbs.

In the northeastern corner of Battelle district the Waynesburg syncline widens out and the low portion shifts eastward to the waters of Miracle run, rendering conditions ideal for the occurrence of the Fourth sand oil pool northeastward from Kimberley, since the latter sand is non-water bearing in this portion of the State. The field was developed during 1900 and 1901 and consists of 80 to 90 wells which had an initial production varying from 10 to 1300 barrels daily. The four following records from this region will show that the drillers have erroneously correlated the producing horizon with the Gordon instead of the Fourth sand, as the former should belong about 2150 feet below the Pittsburgh coal:

A. J. Cumberledge No. 2 Well Record (55).

Battelle district, 0.2 miles southwest of Brave. Authority, South Penn Oil Company. Completed, December 19, 1901.

(Elevation, 1015′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	720	720
Coal, Pittsburgh	....	720
Unrecorded	1290	2010
Big Injun sand (gas and oil, 2020′)	200	2210
Unrecorded	443	2653
Fifty-foot sand	57	2710
Unrecorded	190	2900
Sand, (Gordon)	25	2925
Unrecorded	45	2970
Sand, (Fourth) (gas, 2973′; oil, 3980′) and unrecorded to bottom	24	2994

13¼″ casing, 157′; 10″ casing, 1183′; 8¼″ casing, 1623′; 6 5/8″ casing, 2048′; 5 3/16″ casing, 2232′; 4½x4″ casing, 320′.

Juretta Eddy No. 2 Well Record (56).

Battelle district, 0.5 mile southeast of Shamrock. Authority, South Penn Oil Company. Completed July 1, 1900.

(Elevation, 1275′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded,	900	900
Coal, Pittsburgh	...	900
Unrecorded	1310	2210
Big Injun sand (gas 2230′ and 2240′)	150	2360
Unrecorded	520	2880
Fifty-foot sand	55	2935
Unrecorded	215	3150
Sand, (Fourth)	35	3185
Unrecorded	35	3220
Sand, (Fifth) (oil, 3222′) and unrecorded to bottom	17	3237

10″ casing, 1270′; 8¼″ casing, 1794′; 6 5/8″ casing, 1944′; 5 3/16″ casing, 2240′.

If the above record is correct, the oil pay evidently occurs in the Fifth.

Accha Eddy No. 9 Well Record (58).

Battelle district, at Bula. Authority, South Penn Oil Company. Completed Oct. 11, 1901.

(Elevation, 1010′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	730	730
Coal Pittsburgh	...	730
Unrecorded	1277	2007
Big Injun sand	193	2200
Unrecorded	535	2735
Sand, (Thirty-foot)	65	2800

	Thickness. Feet.	Total. Feet.
Unrecorded	95	2895
Sand, (Gordon)	15	2910
Unrecorded	54	2964
Sand, (Fourth) oil, 2974') and unrecorded to bottom	24	2988

13¼" casing, 130'; 10" casing, 1206'; 8¼" casing, 1999'; 6⅝" casing, 1865'; 5 3/16" casing, 2471'; 4½x4" casing, 207'.

"Initial production, 50 bbls. daily and making 5 bbls. daily in August, 1912."

The **Accha Eddy No. 4 well (59)**, the largest well in the field, had an initial production of 1300 barrels daily from the Fourth sand.

Jerry Merriner No. 1 Well Record (61).

Battelle district, 0.8 mile west of Bula. Authority, South Penn Oil Company. Completed August, 14, 1900.

(Elevation, 1080' B-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded	792	792
Coal, Pittsburgh	..	792
Unrecorded	1283	2075
Big Injun sand	50	2225
Unrecorded	490	2715
Fifty-foot sand (oil and gas, 2715')	55	2770
Unrecorded	200	2970
Sand, (Gordon) (heavy gas, 2970')	18	2988
Unrecorded	45	3033
Sand, Fourth (oil, 3040') and unrecorded to bottom	17	3050

This well starts 30 feet above the Jollytown coal and it was evidently a good gasser in the Gordon as well as an oil producer from the Fourth.

Immediately southwest of the Bula oil pool there are about a dozen gas wells. The two following records from wells in this locality show the main gas pay as the Fourth sand.

Henry Fox Heirs No. 1 Well Record (73).

Battelle district, 0.9 mile N. 75° W. of Miracle Run. Authority, South Penn Oil Company. Completed August 26, 1899.

(Elevation, 1120' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	830	830
Coal, Pittsburgh	..	830
Unrecorded	1260	2090
Big Injun sand (gas, 2170' and 2180')	216	2306

	Thickness. Feet.	Total Feet.
Unrecorded	429	2735
Fifty-foot sand	65	2800
Unrecorded	185	2985
Sand, (Gordon)	30	3015
Unrecorded	40	3055
Sand, (Fourth) (gas, heavy, 3066') and unrecorded to bottom	15	3070

10" casing,146'; 8¼" casing, 1340'; 6 5/8" casing, 2054'; 5 3/16" casing, 2219'; 4½x4" casing, 306'.

Zadoc Wise No. 1 Well Record (74).

Battelle district, 1 mile southwest of Kimberley. Authority, Battelle Oil Company. Completed February 23, 1896.

(Elevation, 1010' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	744	744
Pittsburgh coal	10	754
Unrecorded	1320	2074
Big Injun sand (oil show, 2075') and unrecorded	864	2938
Sand, (Fourth) (strong gas)	3	2941
Black slate	14	2955
Sand, (Fourth) (oil, 2963' and 2973') hard and close	29	2984
Slate to bottom	2	2986

Small oil well in Fourth sand.

The above well was one among the first drilled on the waters of Miracle run and led to the opening of the Fourth sand oil pool in the vicinity of Crossroads, Battelle district. In the latter pool, consisting of 30 to 35 wells, the producing horizon belongs 2210 to 2225 feet below the Pittsburgh coal—60 to 75 feet too low in the measures for the Gordon.

The **Sarah E. Eddy No. 1 well (79)**, located 0.5 mile northwest of Crossroads, the log of which is published on pages 142 and 143 of Vol. I(A) of the State Survey reports, had an initial production of 260 barrels for the first 24 hours and 360 barrels for the second 24 hours from the Fourth sand, in addition to gas pays in the Big Injun and Gordon.

The following is the record of probably the largest oil producer in the Crossroads pool:

Elihu Eddy Heirs No. 6 Well Record (81).

Battelle district, at Crossroads. Authority, South Penn Oil Company. Completed Aug. 31, 1899.

(Elevation, 1160′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	895	895
Coal, Pittsburgh	..	895
Unrecorded	1268	2163
Big Injun sand	187	2350
Unrecorded	445	2795
Fifty-foot sand	95	2890
Unrecorded	153	3043
Sand, (Gordon)	22	3065
Unrecorded	48	3113
Sand, Gordon? (first oil pay, light, 3131′; second oil pay good, 3140′-3145′) ..... 32′ Sand, hard ..... 2 Sand, soft ..... 10 Sand, harder, to bottom 3	(Fourth sand) 47	3160

10″ casing, 350′; 8¼″ casing, 1405′; 6 5/8″ casing, 2080′; 5 3/16″ casing, 2295′; 4½x4″ casing, 830′.

This well had an initial oil production of 2700 barrels daily, but in August, 1912, it had fallen to 3 barrels daily. It starts 110 feet by hand-level above the Jollytown coal.

The following is the detailed log of a light Gordon sand gasser located along the western border of the Crossroads Fourth sand oil pool. The log is interesting in that 4 minable coals are recorded:

M. J. Garrison No. 1 Well Record (80).

Battelle district, 1.2 miles southeast of Wadestown. Authority, South Penn Oil Company.

(Elevation, 1120′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	363	375
Coal, (Washington)	2	377
Unrecorded	103	480
Bluff sand	25	505
Unrecorded	19	524
Fairview (Waynesburg) coal	5	529
Unrecorded	262	791
Mapletown (Sewickley) coal	9	800
Unrecorded	90	890
Pittsburgh coal	6	896
Unrecorded	511	1407
Sand, (I Cow Run)	7	1414
Unrecorded	79	1493
Soft sand	35	1528

	Thickness. Feet.	Total. Feet.
Unrecorded	52	1580
Gas sand	45	1625
Unrecorded	49	1674
Sand, (II Cow Run)	42	1716
Unrecorded, (water, 1700')	134	1850
Salt sand	25	1875
Unrecorded	215	2090
Pencil cave	4	2094
Big Lime	82	2176
Red rock	4	2180
Big Injun sand, (white sand, 2197'; water, 2257'; break, 2289'-2290'	134	3214
Unrecorded	36	2350
Sand, hard	20	2370
Unrecorded	289	2659
Thirty-foot sand	27	2686
Unrecorded	110	2796
Gantz sand	48	2844
Slate	3	2847
Fifty-foot sand (small show of oil and gas, 2801')	29	2876
Unrecorded	109	2985
Sand	23	3008
Unrecorded	4	3012
Gordon Stray sand	18	3030
Unrecorded	12	3042
Gordon sand (oil and gas, 3053')	33	3075
Slate	4	3079
Sand	13	3092
Slate	5	3097
Fourth sand	14	3111
Slate, soft and dark	2	3113
Fifth sand	9	3122
Unrecorded to bottom	19	3141

10" casing, 256'; 8¼" casing, 1429'; 6 5/8" casing, 2287'.

Southward from Crossroads there are found several scattered oil wells in the Fourth sand on Miracle run as is revealed in the two following records:

F. M. Efaw No. 1 Well Record (86).

Battelle district, 1.1 miles S., 5° W. of Crossroads. Authority, Manufacturers' Light and Heat Company. Completed May 2, 1908.

	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	808	824
Mapletown (Sewickley) coal and unrecorded	100	924
Pittsburgh coal	..	924
Unrecorded	410	1334
Little Dunkard sand	21	1355
Unrecorded	95	1450
Big Dunkard sand	15	1465

	Thickness. Feet.	Total. Feet.
Unrecorded	135	1600
Gas sand	50	1650
Unrecorded (top of Salt sand broken up)	180	1830
Second Salt sand	90	1920
Unrecorded	100	2020
Maxton sand	22	2042
Unrecorded	73	2115
Little Lime	15	2130
Pencil cave	15	2145
Big Lime	80	2225
Big Injun sand (water and gas, 2305'; water, 2345')	180	2405
Unrecorded	415	2820
Sand, (Gantz)	30	2850
Unrecorded	205	3055
Sand, (Gordon) white	30	3085
Pencil cave	4	3089
Sand, Gordon, white	37	3126
Pencil cave	3	3129
Sand, (Fourth) (1st pay, 3141') and unrecorded to bottom	18	3147

All pay, not through sand.

"28. H. P. Warren boiler; 30 H. P. Ajax engine; 84' rig. 10" casing, 210'; 8¼" casing, 1436'; 5 3/16" casing, 2351'8". All casing left in well. Cost per foot, $1.20. Shot May 10, 1909, with 10 quarts glycerine, 3½"x6" shell; top of shot, 3141'; bottom, 3147'.

No increase in production.

Production 1st day, 348 bbls. Production 3rd day, 630 bbls.
Production 2nd day, 316 bbls. Production 4th day, 660 bbls.

Amon Johnson No. 2 Well Record (88).

Located in Battelle district, 1.6 miles north of Galletin. Authority, Manufacturers Light & Heat Company. Completed August 26, 1908.

(Elevation, 1083' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	10	10
Unrecorded	736	746
Mapletown (Sewickley) coal	6	752
Unrecorded	106	858
Pittsburgh coal	9	867
Unrecorded	339	1206
Little Dunkard sand	24	1230
Unrecorded	320	1550
Gas sand	62	1612
Unrecorded	140	1752
Salt sand	33	1785
Unrecorded	270	2055
Little Lime	10	2065
Pencil cave	10	2075
Big Lime	75	2150
Big Injun sand (water, 2235' and 2245')	155	2305
Unrecorded	10	2315
Squaw sand	25	2340

	Thickness. Feet.	Total. Feet.
Unrecorded	306	2646
Berea sand	15	2661
Unrecorded	95	2756
Sand, (Gantz)	50	2806
Unrecorded	10	2816
Sand, (Fifty-foot)	36	2852
Unrecorded	155	3007
Sand, (Gordon)	20	3027
Unrecorded	37	3064
Sand, (Fourth) (oil, 3078'-3083') to bottom	22	3086

10" casing, 306'; 8¼" casing, 1397'; 6⅝" casing, 2150'; 5⅛" casing, 2277'.

Southward from Wadestown on the waters of South fork and Range run there are about 100 producing oil wells in the Gordon and Fourth sands. This field is located along and near the axis of the Waynesburg syncline as should be expected, since both the latter sands are non-water bearing in this portion of the State. Many of the wells in this field were first drilled into the Gordon sand from which they produced oil for sometime. Later they were drilled on down to the Fourth to become good oil producers from that horizon. The eight following records of wells in this field give much data of interest:

J. M. Hall No. 2 Well Record (99).

Battelle district, 0.2 mile north of St. Leo. Authority, Manufacturers Light & Heat Company. Completed March 31, 1904.

	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	1048	1060
Mapletown (Sewickley) coal and unrecorded	100	1160
Pittsburgh coal	...	1160
Unrecorded	650	1810
Gas sand	80	1890
Unrecorded	210	2100
Salt sand	80	2180
Unrecorded	270	2450
Big Injun sand	200	2650
Unrecorded	450	3100
Fifty-foot sand (oil show, 3103')	50	3150
Unrecorded	27	3177
Sand, (Thirty-foot) (oil show, 3177')	23	3200
Unrecorded	123½	3323½
Sand (Gordon) (oil, 3332½) to bottom	21	3344½

10" casing, 350'; 8¼" casing, 1565'; 6⅝" casing, 2610'.
"Initial production, 25 bbls. daily."

E. B. Hall No. 1 Well Record (101).

Battelle district, 0.3 mile southwest of St. Leo. Authority, Manufacturers Light & Heat Company. Completed Aug. 18, 1902.

(Elevation, 1080′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	925	925
Pittsburgh coal	...	925
Unrecorded	85	1410
Big Dunkard sand	20	1430
Unrecorded	160	1590
Gas sand	50	1640
Unrecorded	275	1915
Salt sand	30	1945
Unrecorded	245	2160
Big Lime	75	2235
Big Injun sand	185	2420
Unrecorded	460	2880
Fifty-foot sand	60	2940
Unrecorded (little gas, 2980′)	141	3081
Sand (Gordon) (little gas and oil, 3082′)	25	3106
Unrecorded to bottom	1	3107

10″ casing, 265′; 8¼″ casing, 1410′; 6⅝″ casing, 2170′; 5 3/16″ casing 2366′.

This well had an initial production of 25 bbls. daily and had been making 7 bbls. daily for three years, in August, 1911.

Wm. Kinney No. 2 Well Record (104).

Battelle district, 1 mile S 10° E of St. Leo. Authority, Manufacturers Light & Heat Company. Completed Aug. 19, 1907.

	Thickness. Feet.	Total. Feet.
Unrecorded	1105	1105
Pittsburgh coal	...	1105
Unrecorded	1216	2321
Big Injun sand	201	2522
Unrecorded	716	3238
Gordon Stray sand	15	3253
Unrecorded	8	3261
Gordon sand (oil, 3264′-3266′ and 3270′)	34	3295
Unrecorded	37	3332
Gordon sand	12	3344
Unrecorded	14	3358
Fourth sand (oil, 3360′ and 3372′) and unrecorded to bottom	25	3383

10″ casing, 195′; 8¼″ casing, 1513′; 6⅝″ casing, 2362′; 5 3/16″ casing. 2547′; 4½x4″ casing, 220′.

This well encountered oil in both the Gordon and Fourth sands, and in the latter horizon had an initial production of 1000 bbls. daily.

W. A. Yost No. 5 Well Record (107).

Battelle district, 1.4 miles southeast of St. Leo. Authority, South Penn Oil Company. Completed Nov. 23, 1907.

(Elevation, 1295′ B.A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1000	1000
Coal, Mapletown, (Sewickley) and unrecorded	105	1105
Coal, Pittsburgh	...	1105
Unrecorded	1293	2398
Big Injun sand (water, 2490′)	160	2558
Unrecorded	706	3264
Sand, (Gordon) (oil, 3270′)	46	3310
Unrecorded	7	3317
Gordon sand	31	3348
Unrecorded	11	3359
Fourth sand (oil, 3366′)	33	3392
Unrecorded to bottom	3	3395

Wilson Haught No. 4 Well Record (96).

Battelle district, 0.9 mile NE of St. Leo. Authority, South Penn Oil Company.

	Thickness. Feet.	Total. Feet.
Unrecorded	887	887
Coal, Fairview (Waynesburg) and unrecorded	261	1148
Coal, Mapletown (Sewickley)	4	1152
Unrecorded	92	1244
Coal, Pittsburgh (steel line)	9	1253
Unrecorded	497	1750
Sand, Big Dunkard	50	1800
Unrecorded	135	1935
Gas sand	80	2015
Unrecorded	354	2469
Pencil cave	4	2473
Big Lime	72	2545
Big Injun sand (water, 2610′)	170	2715
Unrecorded	441	3156
Fifty-foot sand	103	3259
Unrecorded	4	3263
Thirty-foot sand	17	3280
Unrecorded	111	3391
Sand, (Gordon)	55	3446
Unrecorded	49	3495
Fourth sand (oil, 3499′) and unrecorded to bottom	23	3518

10″ casing, 293′; 8¼″ casing, 177′; 6⅝″ casing, 2500′; 5⅜″ casing, 2676½′; 4″ casing, 180′.

This well had an initial production of 500 bbls. daily.

M. J. (Crocker) Garrison No. 1 Well Record (93).

Battelle district, 1.4 miles south of Wadestown. Authority, South Penn Oil Company. Completed March 12, 1909.

(Elevation, 1075′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	470	470
Bluff sand	55	525
Coal, Fairview (Waynesburg)	5	530
Unrecorded	260	790
Coal, Mapletown (Sewickley)	9	799
Unrecorded	86	885
Coal, Pittsburgh	8	893
Unrecorded	1287	2180
Big Injun sand	140	2320
Unrecorded	480	2800
Sand, (Gantz and Fifty-foot) (oil show, 2829′; gas. 2835′)	100	2900
Unrecorded	75	2975
Thirty-foot sand	54	3029
Unrecorded	5	3034
Sand, (Gordon)	33	3067
Unrecorded	38	3105
Gordon sand	15	3120
Unrecorded	14	3134
Fourth sand (oil, 3144′) and unrecorded to bottom	35	3169

"Initial oil production, 10 bbls. daily from Fourth sand."

M. J. and J. L. Garrison No. 1831 Well Record (82).

Battelle district, 1.1 miles S 10° E of Wadestown. Authority Hope Natural Gas Company. Completed May 19, 1910.

	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	664	680
Coal, native (Waynesburg) and unrecorded	358	1038
Pittsburgh coal (steel line measurement)	...	1038
Unrecorded	397	1435
Little Dunkard sand	15	1450
Unrecorded	80	1630
Big Dunkard sand	20	1650
Unrecorded	185	1835
Gas sand	65	1900
Unrecorded	335	2235
Little Lime	15	2250
Pencil cave	5	2255
Big Lime	65	2320
Big Injun sand (light gas, 2420′) (steel line measurement)	160	2480
Unrecorded	470	2950
Sand, (Gantz and Fifty-foot) (light oil and gas, 2968′ and 2987′)	130	3080
Unrecorded	60	3140
Thirty-foot sand	15	3155
Unrecorded	49	3204
Gordon Stray sand (steel line measurement)	16	3220

	Thickness. Feet.	Total. Feet.
Unrecorded	28	3248
Gordon sand	7	3255
Unrecorded	33	3288
Fourth sand (gas, 3290'-3295') and unrecorded to bottom (steel line measurement)	22	3310

10" casing, 308'; 8¼" casing, 1527'; 6⅝" casing, 2282'; 5⅜" casing, 2686'4"; 4¼x4" liner, 191'; 2" tubing, 3311'; lined at 3204'.

Samuel Eakin No. 4 Well Record (89).

Battelle district, 1.7 miles east of St. Leo. Authority, South Penn Oil Company. Completed Nov. 5, 1898.

(Elevation, 1155' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	865	865
Coal, Mapletown (Sewickley)	8	873
Unrecorded	89	962
Coal, Pittsburgh	8	970
Unrecorded	1275	2245
Big Injun sand (gas show, 2310')	155	2400
Unrecorded	485	2885
Fifty-foot sand (gas show, 2925')	80	2965
Unrecorded	90	3075
Stray sand (oil show, 3075') and unrecorded	45	3120
Gordon sand (oil pay, 3123') and unrecorded	67	3187
Gordon sand (oil,3188') and unrecorded to bottom	7	3194

Along the eastern edge of Battelle district on the Left branch of Miracle run there are 8 to 10 gas wells near Miracle Run P. O. The two following records are from wells in this pool:

John & W. L. Parks No. 1 Well Record (127).

Battelle district, 0.8 mile southeast of Miracle Run. Authority, South Penn Oil Company. Completed February 16, 1908.

(Elevation, 1000' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	780	780
Coal, Pittsburgh	...	780
Unrecorded	1270	2050
Big Injun sand (gas, good, 2058'; salt water, oil show, 2150')	150	2200
Unrecorded	760	2960
Stray sand	18	2978
Unrecorded	2	2980
Gordon sand (broken and shelly)	17	2997
Unrecorded	93	3090
Sand (Fifth) soft and good	10	3100
Unrecorded	48	3148
Sand (Bayard) shelly (gas, light, 3148'-3193') to bottom	45	3193

10" casing, 253'; 8¼" casing, 1271'; 6⅝" casing, 1786'; 5⅜" casing, 2188'; 4½x4" casing, 307'.

Jos. L. Parks No. 1 Well Record (130).

Battelle district, 0.4 mile north of Miracle Run. Authority, South Penn Oil Company. Completed Aug. 8, 1901.

(Elevation, 1080′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	683	683
Coal, Pittsburgh	...	683
Unrecorded	1280	1963
Big Injun sand	151	2114
Unrecorded	499	2613
Fifty-foot sand	45	2658
Unrecorded	184	2842
Sand (Gordon)	35	2877
Unrecorded	40	2917
Sand, (Fourth) (gas, 2921′ and 2934′; lined at 2921′)	37	2954
Slate	5	2959
Fourth sand	32	2991
Unrecorded	79	3070
Fifth sand (gas, 3078′)	10	3080
Slate	67	3147
Bayard sand (gas)	3	3150
Slate to bottom	35	3185

Gas tested 16/10 water in $5\frac{3}{16}$″ casing and 8/10 mercury in 3″ opening.

The test shows the well to have had a volume of 1,000,000 cubic feet daily.

In the southeastern corner of Battelle district there are 125 to 130 producing oil wells from the Fourth and Bayard sands along a structural terrace as exhibited on Map II by the wide divergence of the 300 and the 350-foot contours of the Pittsburgh coal. The small group of wells nearly a mile northeast of Ragtown obtained their oil production from the Big Injun and Fourth sands. No logs were obtained from the latter group. The six following records from wells in the first mentioned field exhibit much data of interest and show that the oil horizons are in the Fourth and Bayard sands instead of the Gordon and Fifth as given by the drillers There the Fourth sand has proved more prolific than the Bayard, some of the wells attaining an initial oil production of over 2000 barrels daily:

S. T. Fordyce No. 1 Well Record (126).

Battelle district, 1 mile northwest of Ragtown. Authority, South Penn Oil Company. Completed December 14, 1906.

(Elevation, 1535' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1256	1256
Coal, Pittsburgh	10	1266
Unrecorded	360	1626
Sand, Little Dunkard	40	1666
Unrecorded	71	1737
Sand, Big Dunkard	60	1797
Unrecorded	159	1956
Gas sand	19	1975
Unrecorded	75	2150
Salt sand	102	2252
Unrecorded	108	2460
Pencil cave	8	2468
Big Lime	77	2545
Big Injun sand	160	2705
Unrecorded	320	3025
Sand, (Berea)	15	3040
Unrecorded	125	3165
Fifty-foot sand	61	3226
Unrecorded	198	3424
Gordon Stray sand	4	3428
Unrecorded	39	3467
Gordon sand	16	3483
Unrecorded	10	3493
Fourth sand (oil pay, 3502' and 3509') and unrecorded to bottom	22	3515

10" casing, 726'; 8¼" casing, 2461'; 6⅝" casing, 2624'; 5 3/16" casing, 2894'.

The above well made an average of 200 bbls. of oil daily for the first month from the Fourth sand. The first 24 hours after completion it made 427 bbls.

Haught and Walker No. 24 Well Record (123).

Battelle district, 0.5 mile S 10° E of Ragtown. Authority South Penn Oil Company. Completed October 16, 1899.

(Elevation, 1420' B-A. T.)	Thickness. Feet.	Total Feet
Unrecorded	1104	1104
Pittsburgh coal	..	1104
Unrecorded	1276	2380
Big Injun sand	130	2510
Unrecorded	500	3010
Fifty-foot sand	50	3060
Unrecorded	210	3270
Sand, (Gordon)	25	3295
Unrecorded	20	3315

	Thickness. Feet.	Total. Feet.
Sand, (Fourth) (gas pay, light, 3324') and unrecorded....	190	3505
Sand, (Bayard) (oil pay, fair, 3505')....	9	3514
Unrecorded to bottom	11	3525

10" casing, 255'; 8" casing, 1617'; 6⅝" casing, 2080'; 5 3/16" casing, 2490'; 4½x4" casing, 322'.

The above well had an initial oil production of 200 bbls. daily from the Fourth sand, and 10 bbls. daily from the Bayard.

Haught and Walker No. 13 Well Record (124).

Battelle district, 0.2 mile south of Ragtown. Authority South Penn Oil Company. Completed April 5, 1899.

(Elevation, 1220' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	909	909
Coal, Pittsburgh	...	909
Unrecorded	1274	2183
Big Injun sand (gas, light, 2275')	140	2323
Unrecorded	487	2810
Fifty-foot sand (fair gas)	50	2860
Unrecorded	215	3075
Stray sand	25	3100
Unrecorded	30	3130
Sand, (Fourth) (oil pay, 3130' and 3133' and unrecorded to bottom	16	3146

10" casing, 280'; 8¼" casing, 1418'; 6⅝" casing, 1890'; 5 3/16" casing, 2340'; 4½x4" casing, 323'.

The above well had an initial oil production of 500 bbls. daily from the Fourth sand.

Corbra Anderson No. 2 Well Record (117).

Battelle district, 1.3 miles southwest of Ragtown. Authority, South Penn Oil Company. Completed January 10, 1906.

(Elevation, 1617' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	12	12
Unrecorded	873	885
Bluff sand	70	955
Fairview (Waynesburg) coal	5	960
Unrecorded	210	1170
Mapletown (Sewickley) sandstone	50	1220
Mapletown (Sewickley) coal	7	1227
Unrecorded	88	1315
Pittsburgh coal	10	1325

	Thickness. Feet.	Total. Feet.
Unrecorded	340	1665
Little Dunkard sand	35	1700
Unrecorded	120	1820
Big Dunkard sand	60	1880
Unrecorded	130	2010
Gas sand	80	2090
Unrecorded	125	2215
Salt sand	115	2330
Unrecorded	200	2530
Little Lime	10	2540
Pencil cave	10	2550
Big Lime	64	2614
Big Injun sand (gas show,2690'; oil show, 2695')	160	2774
Unrecorded	316	3090
Sand, (Berea)	20	3110
Unrecorded	112	3222
Fifty-foot sand	34	3256
Unrecorded	222	3478
Gordon Stray sand	25	3503
Unrecorded	25	3528
Sand (Fourth) (light oil, 3535')	26	3554
Unrecorded	10	3564
Fourth sand	32	3596
Black shale to bottom	173	3769

10" casing, 1335'; 8¼" casing, 1835'; 6⅝" casing, 2330'; 5⅜" casing, 2735'.

Initial oil production, 5 bbls. daily, and still making (Aug. 1911) 2 bbls. daily from Fourth sand.

S. J. Harvey No. 4 Well Record (114).

Battelle district, 1.8 miles northeast of Galletin. Authority South Penn Oil Company.

	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	1131	1145
Pittsburgh coal	...	1145
Unrecorded	1332	2477
Big Injun sand	150	2627
Unrecorded	460	3087
Fifty-foot sand	60	3147
Unrecorded	193	3340
Sand, (Gordon)	20	3360
Unrecorded	1	3361
Sand, (Fourth) (first oil pay, 3362') and unrecorded	37	3398
Fourth sand (first oil pay, 3400') and unrecorded to bottom hole	10½	3408½

The Fourth sand appears to be split into two divisions, both of which were productive.

The **Anna Harvey No. 1 well (110)**, located 1.7 miles N 70° E of Galletin, the log of which is published on page 137 of Vol. I(A) of the State Survey reports, had an initial oil production of 2200 bbls. daily from the Fourth sand when completed in 1897, and was still making 8 bbls. daily in Aug., 1911.

Northeastward the Haught and Walker No. 2, drilled about the same time, had an initial production of 900 bbls. daily from the Fourth sand.

T. C. Gallagher No. 1 Well Record (108).

Battelle district, 0.3 mile northeast of Galletin. Authority, South Penn Oil Company. Completed in 1896.

(Elevation, 1630′ L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	1278	1294
Pittsburgh coal	8	1302
Unrecorded	678	1980
Gas sand	84	2064
Unrecorded	136	2200
Salt sand	43	2243
Unrecorded	272	2515
Big Lime	65	2580
Big Injun sand (oil and water, 2704½′)	138	2718
Break	2	2720
Squaw sand	40	2760
Unrecorded	420	3180
Gantz sand	15	3195
Break	5	3200
Fifty-foot sand	20	3220
Unrecorded	294½	3514½
Sand, (Fourth) (oil, 3523′) and unrecorded to bottom	26½	3540

10″ casing, 419′; 8¼″ casing, 1830′; 6⅝″ casing, 2570′; 5 3/16″ casing, 2770′.

Prospective Oil and Gas Areas, Battelle District.—This district has been quite thoroughly drilled over, yet there remain a few small areas favored both by structure and development that would justify further drilling for oil and gas. (1) That portion in the northwest corner of the district lying immediately north of the straight line joining the S. L. S. Spragg No. 1 well (4) and the Eli White No. 1 (5) appears favorable for gas in the Big Injun, Gantz, Thirty-foot and Fourth sands; (2) that, southwestward along the crest of the Amity anticline from Maple to Pone run, for gas at the

same horizons; (3) that, in the St. Leo region immediately west to the Wetzel county line from the E. B. Hall No. 2 well (100), for oil in the Thirty-foot and Gordon sands; (4) that, on the upper portion of Browns and Joy runs—branches of Camp—for gas in the Big Injun, Fifty-foot, Fourth and Fifth sands; (5) that, southward from the State line to Yeager run immediately along the axis of the Waynesburg syncline, for oil in the Fourth sand, or same horizon as that in which the oil was obtained in the Ed. Clovis No. 1 well (17), located 0.5 mile northeast of Jollytown, with a chance for gas in the Big Injun; (6) that, northeastward from Miracle Run P. O. to the Battelle-Clay district line, for gas in the Big Injun, Gordon, Fourth and Sixth; and (7), that, along both hillsides of Miracle run southward from Crossroads to the Efaw (87) and Johnson (88) wells for several new producers in the Fourth sand.

Clay District.

Clay district, Monongalia, lies immediately east of Battelle district and adjoins Greene county, Pa., on the north and Marion county, W. Va., on the south. Map II shows its area traversed by four structural folds, viz.; Bellevernon and Mooresville anticlines, and Whiteley and Lambert synclines; hence, its strata are very much warped and tilted as in Battelle, making ideal conditions for the accumulation of the great oil and gas pools therein. The main producing horizons have been the Big Injun, Fourth, Fifth and Bayard sands. The Mt. Morris-Fairview oil field extends in an unbroken belt of wells entirely across the district, following roughly between the 500 and 600-foot contours of the Pittsburgh coal as exhibited on Map II. A small pool of oil in the Bayard sand occurs along Dunkard creek in the northern edge of the district, 0.8 mile northeast of Worley. A narrow belt of Big Injun oil wells extends across the northwest corner of the district from Blacksville southwest to its intersection with the Clay-Battelle line, 2 miles west of Daybrook. A number of gas wells occur along the crest of the Bellevernon anticline in the vicinity of Blacksville; the crest of the Mooresville arch, near Mooresville; and southeast of the

Mt. Morris-Fairview oil belt. The development of the different fields will now be discussed from northwest to southeast across the district.

In the northwestern corner of Clay there are about a dozen gas wells on and near the crest of the Bellevernon anticline, where the principal producing horizon is the Big Injun sand. The four following records exhibit the minute pressure and other data of interest:

R. S. Thomas No. 1 Well Record (131).

Clay district, 2.3 miles southwest of Blacksville. Authority, Mellon Bros. Completed in 1891.

(Elevation, 968′ L-A. T.)	Thickness. Feet.	Total. Feet
Unrecorded	1680	1680
Lime and unrecorded	225	1915
Big Injun sand (gas, 1930′-1950′; break, 2055′)	181	2096

10″ casing, 150′; 7⅝″ casing, 650′; 6¼″ casing, 1225′; 4⅞″ casing, 1730′.

This well blew into the air for several years, according to R. S. Thomas, since it was drilled long before the great gas mains were completed in this region; hence, it was considered the same as a dry hole.

Estella and R. S. Lantz No. 1589 Well Record (135).

Clay district, 0.5 mile west of Blacksville. Authority, Philadelphia Company. Completed Aug. 21, 1906.

	Thickness. Feet.	Total. Feet.
Unrecorded	546	546
Mapletown (Sewickley) coal and unrecorded	82	628
Pittsburgh coal	...	628
Unrecorded	1320	1948
Big Injun sand (gas, 2054′) and unrecorded to bottom	116	2064

Pressure test:

1st ½ minute, 40 lbs.
1st minute 80 lbs.
2nd minute 140 lbs.
5th minute, 320 lbs.
10th minute, 420 lbs.
20th minute, 445 lbs.
30th minute, 447 lbs.
60th minute, 450 lbs.
Rock pressure in 16 hours, 455 lbs.

Estella and R. S. Lantz No. 1575 Well Record (136).

Clay district, 0.4 mile southwest of Blacksville. Authority, Philadelphia Company. Completed Oct. 24, 1905.

(Elevation, 955′ B-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded (gas, 430′)	490	490
Mapletown (Sewickley) coal	...	490
Unrecorded	80	570
Pittburgh coal	...	570
Unrecorded	1335	1905
Big Injun sand (gas, 1970′) and unrecorded to bottom	85	1990

First pressure test in 5⅜″ casing.

1st ½ minute, 135 lbs.
1st minute, 230 lbs.
2nd minute, 385 lbs.
5th minute, 635 lbs.
Rock pressure, 695 lbs.

Estella and R. S. Lantz No. 1576 Well Record (137).

Clay district, at Blacksville. Authority, Philadelphia Company.

(Elevation, 952′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	476	476
Mapletown (Sewickley) coal	6	482
Unrecorded	79	561
Pittsburgh coal	8	569
Unrecorded	1311	1880
Big Injun sand (gas, 1968′-1976′) and unrecorded to bottom	100	1980

"Rock pressure, 660 lbs."

The above well is reported to have had a showing of oil.

The Strosnider No. 1 well (138), located in the south edge of Blacksville and drilled by the Scott Oil & Gas Company, is reported as having had an initial oil production of 50 barrels daily from the Big Injun and 3 to 4 barrels daily from the Fourth sand. It is quite probable that the deep oil pay in this well was in the Fifth instead of the Fourth sand, since Stone & Clapp[5] report the Wm. Scott (L. L. Thomas) No. 1 well (140), one-eighth mile northeastward as a Fifth sand oil producer. No log was obtained from the Strosnider well.

As mentioned under the description of the Bellevernon anticline, the latter fold dies down within a mile and a half after entering Clay district from Pennsylvania, and forms a terrace-like structure southwestward from Kings run to the Clay-Battelle district line, 2 miles west of Daybrook. Closely

5. Bull. 304, Oil & Gas Fields, Greene Co., Pa., U. S. G. Survey, p. 58; 1907.

following this terrace is a belt of 30 to 40 Big Injun sand oil wells. The following records from wells scattered throughout this field exhibit the oil horizon and the initial production of some of the borings:

Sol Meyers No. 1 Well Record (148).

Clay district, 1.3 miles S 10° W of Blacksville. Authority J. H. McDermott. Completed Dec. 29, 1904.

(Elevation, 1110′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	340	340
Bluff sand and unrecorded	60	400
Coal, Fairview (Waynesburg) and unrecorded	248	648
Coal, Mapletown (Sewickley)	...	648
Unrecorded	108	756
Coal, Pittburgh	...	756
Unrecorded	840	1596
Salt sand and unrecorded	455	2051
Big Injun sand (first gas, 2068′; second pay of oil and little water, 2176′)	99	2250
Unrecorded to bottom	6½	2256½

"10" casing, 1120′; 8¼" casing, 1556′; 6¼" casing, 1796′ (steel line measurement); $5\frac{3}{16}$" casing, 2021′ (steel line measurement). Lead plug at 2105′ to shut off water. Gas enough to run 15 drilling wells. Rock pressure 360 lbs."

Sol. Meyers No. 1 Well Record (147).

Clay district, 1.2 miles south of Blacksville. Authority, Carnahan and Debendorfer. Completed Jan. 18, 1905.

(Elevation, 1104′ L-A. T.)	Thickness. Feet.	Total Feet.
Conductor	12	12
Unrecorded	316	328
Bluff sand and unrecorded	72	400
Coal, Fairview (Waynesburg) and unrecorded	255	655
Coal, Mapletown (Sewickley)	...	655
Unrecorded	89	744
Coal, Pittsburgh	...	744
Unrecorded	571	1315
Dunkard sand	80	1395
Unrecorded	165	1560
Sand (II Cow Run and Salt) (water, 1590′)	204	1764
Unrecorded	234	1994
Big Lime	40	2034
Big Injun sand (first oil pay, 2140′; second oil pay and water, 2156′-2158′) and unrecorded to bottom	128	2162

13" casing, 120′; 10" casing, 1130′; 8¼" casing, 1569′; 6⅝" casing, 1764′; $5\frac{3}{16}$" casing, 1994′.

The above well had an initial oil production of 30 bbls daily from the Big Injun, and was still making 10 bbls. daily in August, 1911.

Reason Sine No. 1 Well Record (149).

Clay district, 1.5 miles south of Blacksville. Authority, Carnahan and Debendorfer. Completed in 1905.

(Elevation, 1239' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	524	540
Coal, Fairview (Waynesburg) and unrecorded	252	592
Coal, Mapletown (Sewickley)	...	792
Unrecorded	98	890
Coal, Pittsburgh	...	890
Unrecorded (water, 1805')	1279	2169
Big Lime	14	2185
Big Injun sand (gas, 2205-2215'; oil, 2173')		

13" casing, 258'; 10" casing, 1271'; 8¼" casing, 1742'; 6⅝" casing, 1934'; 5⅛" casing, 2169'.

Initial oil production, 5 bbls. daily from Big Injun.

Alpheus Sine No. 1 Well Record (150).

Clay district, 1.5 miles S 5° W of Blacksville. Authority, Carnahan and Debendorfer. Completed in 1904.

(Elevation, 1152' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	700	700
Coal, Mapletown (Sewickley)	...	700
Unrecorded	100	800
Coal, Pittsburgh	...	800
Unrecorded	385	1185
Little Dunkard sand and unrecorded	175	1360
Big Dunkard sand and unrecorded	220	1580
Salt sand	248	1828
Unrecorded	200	2025
Big Lime	55	2080
Big Injun sand (gas, 2107'-2115'; oil, 2180'-2214') and unrecorded to bottom	134	2214

13" casing, 40'; 10" casing, 1185'; 8¼" casing, 1593'; 6⅝" casing, 1828'.

This well had an initial oil production of 50 bbls. daily from the Big Injun, and was still making 8 bbls. daily in August, 1911.

Alpheus Sine No. 2 Well Record (151).

Clay district, 1.6 miles S 10° W of Blacksville. Authority, Carnahan and Debendorfer.

(Elevation, 1274′ L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	13	13
Unrecorded	532	545
Bluff sand and unrecorded	371	916
Coal, Pittsburgh	...	916
Unrecorded	564	1480
Big Dunkard sand and unrecorded	220	1700
Sand, (II Cow Run, Salt) (water, 1925′) and unrecorded	345	2045
Big Lime	64	2109
Big Injun sand (gas, 2236′-2260′) and unrecorded	621	2730
Sand, (Berea)	20	2750
Unrecorded	116	2866
Fifty-foot sand	60	2926
Unrecorded	259	3185
Sand, (Fourth)	40	3225
Unrecorded	21	3246
Sand, (Fifth)	2	3248
Unrecorded	85	3333
Sand, (Bayard) (gas, 3333′)	3	3336
Unrecorded	32	3368
Bayard sand to bottom	3	3371

13″ casing, 149′; 10″ casing, 1280′; 8″ casing, 1700′; 6⅝″ casing, 1925′; 5 3/16″ casing, 2145′.

In the above well the driller has erroneously correlated the Bayard sand as the Fifth, and although in the immediate vicinity of the Big Injun oil producers on the Myers farm, it proved a gasser at the latter horizon as well as in the Bayard.

Asa Lemley No. 2 Well Record (152).

Clay district, 2.1 miles south 10° west of Blacksville. Authority, South Penn and Carter Oil Companies.

(Elevation, 1195′ B- A. T.)	Thickness. Feet.	Total. Feet.
Loam	12	12
Slate	51	63
Unrecorded	12	75
Sand	25	100
Slate	310	410
Sand, Bluff (Waynesburg)	70	480
Coal, Waynesburg	7	487
Slate and lime	263	750
Coal, Mapletown, (Sewickley)	6	756
Lime	90	846
Coal, Pittsburgh	9	855
Slate, red rock, etc	372	1227

	Thickness. Feet.	Total. Feet.
Little Dunkard sand	23	1250
Slate	75	1325
Dunkard sand	27	1352
Slate	88	1440
"Gas" (and H Cow Run) sand	225	1665
Slate and lime	35	1700
Salt sand	170	1870
Red rock	199	2069
Little Lime	6	2075
Pencil cave	5	2080
Big Lime	52	2132
Big Injun sand (gas, 2158'; break, 2227'-2232')	238	2370
Slate and shells	280	2650
Unrecorded	100	2750
Gantz sand	25	2775
Slate and shells	20	2795
Fifty-foot sand	105	2900
Slate	30	2930
Thirty-foot sand	25	2955
Slate	20	2975
Gordon Stray sand	35	3010
Red rock	106	3116
Sand, (Fourth)	16	3132
Slate and shells	124	3256
Sand, (Bayard)	5	3261
Slate to bottom	186	3447

13" casing, 75'; 10" casing, 1200'; 8¼" casing, 1732'; 6⅝" casing, 1864'; 5⅜" casing, 2125'.

James Lemley Heirs No. 1 Well Record (153).

Clay district, 1.6 miles northwest of Daybrook. Authority, Fisher Oil Company. Completed February 25, 1905.

(Elevation, 1225' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	515	515
Coal, Fairview (Waynesburg) and unrecorded	265	780
Coal, Mapletown (Sewickley)	...	780
Unrecorded	95	875
Coal, Pittsburgh	...	875
Unrecorded	450	1325
Dunkard sand and unrecorded	350	1675
Salt sand	15	1690
Unrecorded	420	2110
Big Lime	45	2155
Big Injun sand (gas, 2170' and 2240'; and oil, 2248' and 2281'), and unrecorded to bottom	143	2298

13" casing, 81'; 10" casing, 1200'; 8¼" casing, 1750'.

The above well was a light oil producer from Big Injun, but had been abandoned in August, 1911.

D. S. Lemley No. 1 Well Record (158).

Clay district, 1.5 miles northwest of Daybrook. Authority, South Penn Oil Cimpany.

(Elevation, 1480′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1155	1155
Pittsburgh coal		1155
Unrecorded	281	2436
Big Injun sand (first oil pay, 2531′; second oil pay, 2539′) and unrecorded to bottom	106	2542

The above well had an initial oil production of 30 bbls. when drilled about 12 years ago and was still making 3 bbls. daily in August, 1911.

D. S. Lemley No. 1 Well Record (159).

Clay district, 1.8 miles N 80° W of Daybrook. Authority, Char tiers Oil Company. Completed March 10, 1906.

(Elevation, 1165′ B- A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	856	856
Pittsburgh coal	6	862
Unrecorded (salt water, 1736′-1847′; cave, 1100′)	1254½	2116½
Big Injun sand (gas, 2122½′, 2127½′ 2159′, 2210′; oil, 2223′) and unrecorded to bottom	119¼	2235¾

"Show of oil and gas, 2223′. Ran one bit one hour and filled up and flowed while pulling tools. Made several small flows during day.'

"Shot Oct. 1, 1907, with 15 quarts. Top of shot, 2222½′."

13″ casing, 99′; 10″ casing, 1156′; 8¼″ casing, 1748′: 6⅝″ casing, 1872′; 5⅜″ casing, 2150′. Contract price per foot, $1.00.

This well had an initial oil production of 25 to 30 bbls daily from the Big Injun, and was still making 4 bbls. daily in August, 1911. It starts 10 to 20 feet above the Jollytown coal.

The **Marion Tennant No. 1 well (162)**, located one mile west of Daybrook, the log of which is published on page 135 of Vol. I(A) of the State Survey reports, had a good oil show in the Big Injun, and a gas pay in the Bayard sand.

The three following records are from wells in the Whiteley Basin, along or near the main valley of Days run:

John Henderson Heirs No. 1 Well Record (163).

Clay district, 0.5 mile south of Daybrook. Authority, Chartiers Oil Company. Completed July 1, 1908.

(Elevation, 1020' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	635	635
Pittsburgh coal	...	635
Unrecorded (water, 1620')	1235	1870
Big Lime	62	1932
Big Injun sand (oil and water, 2036' and 2062')	193	2125
Unrecorded	450	2575
Fifty-foot sand	80	2655
Unrecorded	405	3060
Sand, (Bayard) (small oil show, 3065')	5	3065
Unrecorded (gas, 3090½' and 3094½') to bottom	173	3238

"13" casing, 269' 4"; 10" casing, 963' 4"; 8¼" casing, 1513' 6"; 6⅝" casing, 1663' 6"; 5⅜" casing, 2175'. Measurements do not include threads."

Mary Berry No. 1 Well Record (164).

Clay district, 0.9 mile northeast of Daybrook. Authority, Chartiers Oil Company. Completed August 26, 1905.

(Elevation, 990' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	596	596
Pittsburgh coal	...	596
Unrecorded (salt water, 1525')	1299	1895
Big Injun sand (gas) and unrecorded	131½	2026½

"Fifty pound (gas well in top of sand). Small show of oil. Filled up 500' first bit. Salt water at 2003'."

10" casing, 625'; 8¼" casing, 830'; 6⅝" casing, 1615'; 5⅜" casing, 1900'; 2" tubing, 2026'.

A farmer living near the well reported it as having a rock pressure of 500 pounds, but the salt water at 2005 feet drowned out the gas. In the writer's judgment it is too low down in the Whiteley Basin to have lasted very long in any event.

John Moore No. 1 Well Record (165).

Clay district, 1.2 miles S 80° W of Mooresville. Authority, Chartiers Oil Company. Completed Sept. 3, 1901.

(Elevation, 960' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	555	555
Pittsburgh coal	...	555
Unrecorded	1305	1860
Big Injun sand	194	2054
Unrecorded	391	2445

	Thickness. Feet.	Total. Feet.
Fifty-foot sand	73	2518
Unrecorded	79	2697
Gordon Stray sand	8	2705
Unrecorded	81	2786
Sand, (Fourth)	10	2796
Unrecorded	28	2824
Sand, (Fifth)	10	2834
Unrecorded	168	3002
Sand, (Bayard) (gas, 3002'and 3012½')	13	3015
Slate and shells to bottom	246	3261

13" casing, 155'; 10" casing, 942'; 8¼" casing, 1442'; 6⅝" casing, 1600'; $5\frac{3}{16}$" casing, 2012'.

"Nice flow of gas and increased at 3012½'. Probably make 30 lbs. pressure minute in $5\frac{3}{16}$ " casing.

Worley Oil Pool.—About one mile northeast of Worley in the northern edge of Clay district, the Mooresville anticline dies down northward into a "saddle-like" form, and thereon is found a small oil pool of one-half dozen wells in the Bayard sand. Some of the wells made oil from the Big Injun. The logs of the **Brown Heirs No. 1 (177)** and **Lee R. Shriver No. 1 (176)** are published on pages 234-235 and 235-236, respectively of Vol. I of the State Survey reports. The Brown well had a good showing of oil in the Big Injun, and gas in the Fifth sand; while the Shriver well produced oil and gas from both the Big Injun and Bayard sands. The following records from other wells in this field give much data of interest:

John Blair No. 1 Well Record (178).

Clay district, 1 mile N 15° E of Worley. Authority, South Penn Oil Company. Completed in 1896.

	Thickness. Feet.	Total Feet.
Conductor	12	12
Unrecorded	526	538
Pittsburgh coal	...	538
Unrecorded	1282	1820
Big Injun sand (salt water, 1925')	154	1974
Unrecorded	886	2860
Dark shells and slate	92	2952
Sixth sand (first pay, 2952')	2	2954
Dark shells and slate	36	2990

"10" casing, 553' 6"; 8¼" casing, 1453'; 6⅝", 1598' 4"; $5\frac{3}{16}$" casing, 1964' 3". 4 to 5 barrel oil show in Sixth or Bayard sand. Abandoned Dec. 10, 1896."

The above was the first well drilled in this field.

Lee R. Shriver No. 2 Well Record (172).

Clay district, 0.6 mile northeast of Worley. Authority, South Penn Oil Company. Completed December 9, 1897.

(Elevation, 965' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	195	195
Mt. Morris (Waynesburg) coal	..	195
Unrecorded	259	454
Mapletown (Sewickley) coal	...	454
Unrecorded	81	535
Pittsburgh coal	...	535
Unrecorded	150	685
Sand	95	780
Blue and red cave	90	870
Shells	15	885
Sand, (Saltsburg)	30	915
Slate and shells	95	1010
Little Dunkard sand	40	1050
Slate	60	1110
Coal (Upper Freeport)	2	1112
Slate	93	1205
Coal, (Upper Kittanning)	2	1207
Slate and shells	73	1280
Gas sand	40	1320
Slate	7	1327
Sand, (II Cow Run)	43	1370
Slate	6	1376
Salt sand (water, 1415')	69	1445
Slate and shells	155	1600
Red rock	65	1665
Slate and shells	40	1705
Red rock	12	1717
Little Lime	38	1755
Big Injun sand (gas, 1882'; oil and water, 1903'; water, 1915')	173	1928
Slate	57	1985
Sand, (Squaw)	55	2040
Slate and shells	28	2068
Sand and shells	307	2375
Slate and pebbles	65	2440
Sand	5	2445
Slate and shells	15	2460
Sand, (Gantz)	20	2480
Slate	25	2505
Sand, (Fifty-foot)	25	2530
Slate	15	2545
Sand	5	2550
Red rock	5	2555
Sand	3	2558
Red rock	12	2570
Sand, (Thirty-foot)	70	2640
Slate and shells	20	2660
Red rock	35	2695
Sand, (Gordon Stray)	25	2720
Shells	40	2760

	Thickness. Feet.	Total. Feet.
Fourth sand	15	2805
Slate and shells	35	2840
Gordon sand	8	2768
Slate and shells	22	2790
Fifth sand	5	2845
Slate	57	2902
Sand, (Bayard) (oil and gas, 2943'-2949')	47	2949
Slate to bottom	11½	2960½

10" casing, 565' 7"; 8" casing, 1405'; 6⅝" casing, 1572' 4"; 4" liner, 1018' 3"; 4" inserted casing, 2906'.

The above record gives all the main producing sands of the Catskill measures in West Virginia, and shows the formation at 2902' to be the Bayard. Two Allegheny coals are noted; viz., Upper Freeport and Upper Kittanning.

Lee R. Shriver No. 3 Well Record (174).

Clay district, 0.8 mile northeast of Worley. Authority, South Penn Oil Company. Completed June 29, 1898.

(Elevation, 975' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	21	21
Unrecorded	427	448
Coal, Mapletown (Sewickley)	...	448
Unrecorded	92	540
Pittsburgh coal	...	540
Unrecorded	1250	1790
Big Injun sand (gas, 1880'; oil, 1900') and unrecorded to bottom	138	1928
10" casing, 568'; 6⅝" casing, 1560'. Shot May 28, 1900 with 10 quarts. Shot July 6, 1901, with 16 quarts. Shot Sept. 29, 1904, with 10 quarts. Drilled deeper Oct. 4, 1904.		
Unrecorded	496	2424
Sand (Gantz) (gas show, 2452') and unrecorded (first oil pay in Bayard, 2927', to bottom	544	2968

5 3/16" casing, 1952' 9"; 4" casing, 433' 11"

The above well had an initial oil production of 10-15 bbls. from the Big Injun sand, but it was producing oil from the Bayard in August, 1911, the latter having about the same initial daily production.

J. O. & E. Price No. 1 Well Record (173).

Clay district, 0.7 mile northeast of Worley. Authority, Jos. McDermott. Completed June 6, 1910.

(Elevation, 990′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	40	40
Unrecorded	512	552
Coal, Pittsburgh	9	561
Unrecorded	1259	1820
Big Injun sand (gas show, 1855′; oil show and water, 1913½″)	230	2050
Unrecorded	335	2385
Sand, (Berea, Gantz and Fifty-foot) (gas, small, 2440′)	170	2555
Unrecorded	120	2675
Sand, (Gordon)	40	2715
Unrecorded	120	2835
Sand, (Fifth)	20	2855
Unrecorded	96	2951
Sand, (Bayard)	2	2953
Unrecorded (oil show in slate, 2966′)	45	2998
Bayard sand	2	3000
Slate and shells to bottom	190	3190

13″ casing, 58′, to shut off quicksand; 10″ casing, 580′; 8¼″ casing, 1396′; 6⅝″ casing, 1585′; 5⅜″ casing, 1950′.

The above well is drilled on old drainage terrace of Dunkard creek; hence, the large amount—58 feet—of 13″ casing required to shut off quicksand.

Southward from Worley along the crest of the Mooresville anticline to just south of Mooresville, there occurs a small gas field consisting of one-half dozen wells. The Big Injun, Fourth, Fifth and Bayard are main producing horizons. The following record gives much data as to the sands and coal beds:

Etta Core No. 2268 Well Record (171).

Clay district, 0.5 mile southwest of Worley. Authority, Hope Natural Gas Company. Completed Nov. 10, 1911.

(Elevation, 1345′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	160	160
Coal, Jollytown (12 bailers water, 160′)	2	162
Unrecorded	198	360
Coal, Washington	4	364
Unrecorded	121	485
Coal, Waynesburg	5	490
Unrecorded	78	568
Coal, Uniontown	7	575
Unrecorded	233	808

	Thickness. Feet.	Total. Feet.
Mapletown (Sewickley) coal	7	815
Unrecorded	77	892
Pittsburgh coal	10	902
Unrecorded	348	1250
Little Dunkard sand	30	1280
Unrecorded	110	1390
Big Dunkard sand	80	1470
Unrecorded	98	1568
Gas sand (gas, 8/10 mercury in 2" tubing, 1580')	82	1650
Unrecorded	59	1709
First Salt sand	26	1735
Unrecorded	20	1755
Second Salt sand (hole full of water, 1759')	143	1898
Unrecorded	157	2055
Little Lime	15	2070
Pencil cave	22	2092
Big Lime	53	2145
Big Injun sand (gas, 8/10 mercury in 2" tubing, 2175'-2185')	104	2249
Unrecorded	3	2252
Squaw sand	130	2382
Unrecorded	58	2440
Berea sand	45	2485
Unrecorded (no Gantz sand)	293	2778
Fifty-foot sand	30	2808
Unrecorded	15	2823
Fifty-foot sand	22	2845
Unrecorded	5	2850
Thirty-foot sand	25	2875
Unrecorded	149	3024
Gordon Stray sand	11	3035
Unrecorded	85	3120
Gordon sand (broken)	15	3135
Unrecorded	15	3150
Fourth sand	10	3160
Unrecorded	9	3169
Sand	8	3177
Unrecorded	11	3188
Sand, (Fifth) (gas show, 3190')	14	3202
Unrecorded	97	3299
Sand, (gas, 3302').....14' Sand, unrecorded..... 2 Sand (oil show, 3318')..... 9 } **(Bayard sand)**	25	3324
Unrecorded to bottom	24	3348

10" casing, 914'; 8¼" casing, 1760'; 6⅝" casing, 2112'; 5 3/16" casing, 3027'.

The gage test in the Big Injun is equivalent to 500,000 cu. ft. of gas daily. The Bayard oil showing was for about 2 bbls. daily.

Mt. Morris-Fairview Oil Belt, Clay District.—This great oil field enters Clay district from the northeast on the head

of Smoky drain, slightly over a mile northeast of Core, bears S 25° W to a point 1.5 miles south of Core, with a width of ¾ to 1 mile, and then suddenly veers to the westward around a structural terrace on the nose of the Mooresville anticline to a point one mile west of Statler Run P. O., where it has a width of almost 3 miles. From the latter point the field again resumes a southwest course to its intersection with the Monongalia-Marion county line, 1.4 miles north of Fairview, maintaining a width in this portion of 1½ to 2 miles. Within the boundaries of Clay this field has had 440 to 450 producing oil wells largely in the Big Injun and Bayard sands, with the former horizon far in the lead both in the number of wells and in the total amount of oil produced. The Big Injun oil wells occur throughout the length of the belt across the district, but the Bayard wells are confined to that portion of the field southwest of a line joining Daybrook and Sandy. This oil belt was correctly located and followed from the Pennsylvania line throughout its devious course across Monongalia county and also across Marion in 1888 by I. C. White in demonstration of the structural theory of oil and gas which he discovered in 1883.

The four following logs are from wells in that portion of the oil belt northeast of Dolls run, where the production is from the Big Injun sand only:

C. C. Core No. 7 Well Record (223).

Clay district, 1.1 miles northeast of Core. Authority, South Penn Oil Company. Completed Jan. 1, 1907.

(Elevation, 1340′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	20	20
Unrecorded	756	776
Pittsburgh coal	...	776
Unrecorded	1304	2080
Big Injun sand (gas, 2163′; oil, 2182′) and unrecorded to bottom	129	2209

10″ casing,; 810′ 8¼″ casing, 1665′; 6⅝″ casing, 1846′; 5⅜″ casing, 243′.

"Shot April 6, 1908, with 10 quarts; 3½″x5′ shell. Shot May 3, 1910, with 16 quarts.

The above well had an initial oil production of 10 bbls. daily, and in September, 1911, was still making 3 bbls. daily.

Thos. Sutton No. 2 Well Record (222).

Clay district, 1 mile northeast of Core. Authority, South Penn Oil Company. Completed about 1889.

(Elevation, 1365′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	2182	2182
First pay (in Big Injun sand) and unrecorded to bottom..	46	2228

6¼″ casing, 600′; 4⅞″ casing, 1900′; 4″ liner, 261′.

The above well had an initial oil production of 250 bbls. daily, and in September, 1911, was still making 2½ bbls. daily.

C. C. Core No. 3 Well Record (221).

Clay district, 1.2 miles northeast of Core. Authority, South Penn Oil Company. Completed Feb. 1, 1895.

(Elevation, 1440′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	860	860
Pittsburgh coal	...	860
Unrecorded	1300	2160
Big Injun sand (break, 2255′-2270′) first pay 2270′) and unrecorded to bottom	140	2300

10″ casing, 880′; 8¼″ casing, 907′; 6⅝″ casing, 1901′; 5 3/16″ casing, 2180′.

Shot Feb. 11, 1897, with 3 quarts; Feb. 2, 1899, with 10 quarts; Jan. 6, 1900, with 16 quarts; May 4, 1901, 30 quarts; Aug. 26, 1902, with 40 quarts; April 1, 1905, with 60 quarts.

The above well had an initial oil production of 75 bbls. daily and Sept., 1911, was still making 4 bbls. daily. The lasting qualities of the Big Injun wells in the Mt. Morris-Fairview field are second to none in the State.

Asa Sutton No. 6 Well Record (220).

Clay district, 1.2 miles northeast of Core. Authority, South Penn Oil Company. Completed July 27, 1895.

(Elevation, 1485′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	20	20
Unrecorded	900	920
Pittsburgh coal	...	920
Unrecorded	1308	2228
Big Injun sand (first oil pay, 2289′) and unrecorded to bottom	132	2360

10″ casing, 951′; 8¼″ casing, 941′; 6⅝″ casing, 1965½′; 5 3/16″ casing, 2238′.

Shot Feb. 11, 1897, with 3 quarts; May 28, 1898, with 10 quarts; and July 20, 1899, with 16 quarts.

"Initial oil production, 75 bbls., but abandoned Nov. 14, 1900."

The **D. E. Lemley No. 1 well (217A)**, located 1 mile southeast of Core on the east edge of the oil belt and drilled in 1890 by E. M. Hukill was the first oil producer to be obtained in this Big Injun pool between Dolls run and the W. Va.-Penna. State line. Its initial production was 10 to 15 bbls. daily.

The two following are the records of wells that were drilled slightly too far northwest down the structural slope to catch the main oil belt in the Big Injun, the result being salt water. The same also happened at the **Kate Core No. 2 well (219)**, located 0.5 mile north of Core:

(Kate) Benjamin Core No. 1 Well Record (218).

Clay district, at Core. Authority Chartiers Oil Co. Completed Oct. 17, 1897.

(Elevation, 949' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	512	512
Pittsburgh coal	...	512
Unrecorded	1268	1780
Big Injun sand (oil, 1862' and 1870') and unrecorded to bottom	129	1909

10" casing, 546'; 8¼" casing, 812'; 6⅝" casing, 1543'; 5⅜" casing, 1780'.

"First pay, little oil, gas and salt water; second pay, big dose of salt water, filled up 1200' in short time."

M. C. Wildman No. 1123 Well Record (217).

Clay district, 0.6 mile southwest of Core. Authority, Hope Natural Gas Company. Completed April 24, 1909.

(Elevation, 1130' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	302	316
Coal, native (Waynesburg)	5	321
Unrecorded	354	675
Pittsburgh coal, (steel line measurement)	8	683
Unrecorded	287	970
Sand, (Moundsville)	30	1000
Unrecorded	150	1150
Sand, (I Cow Run)	20	1170
Unrecorded	36	1206
Sand, Big Dunkard	34	1240
Unrecorded	86	1326
Gas sand (steel line measurement)	20	1346
Unrecorded	154	1500
Sand, (II Cow Run) (15 ten-foot bailers of water)	20	1520
Unrecorded	38	1558

	Thickness. Feet.	Total. Feet.
Salt sand	42	1600
Unrecorded	33	1633
Salt sand and unrecorded	107	1740
Maxton sand	60	1800
Unrecorded	64	1864
Little Lime	20	1884
Pencil cave	2	1886
Big Lime	44	1930
Big Injun sand (2 bailers of water; gas and oil, 2050′; steel line measurement)	179	2109
Unrecorded	41	2150
Squaw sand	20	2170
Unrecorded	340	2510
Sand, (Berea)	35	2545
Unrecorded	23	2568
Sand, (Gantz)	27	2595
Unrecorded	5	2600
Fifty-foot sand (steel line measurement)	25	2625
Unrecorded	29	2654
Red rock	6	2660
Thirty-foot sand	15	2675
Unrecorded	125	2800
Gordon Stray sand	5	2805
Unrecorded	30	2835
Sand, hard, (Gordon)	15	2850
Unrecorded	62	2912
Sand, (Fourth)	7	2919
Unrecorded	31	2950
Sand, (Fifth)	22	2972
Unrecorded	96	3068
Sand	4	3072
Unrecorded	2	3074
Sand, (Bayard) (steel line measurement)	4	3078
Unrecorded	152	3230
Sand, (Elizabeth) (steel line measurement)	20	3250
Unrecorded to bottom	85	3335

Shot April 27, 1909, in Big Injun with 30 quarts of nitro-glycerine; 8′ shell; top of shell, 2048′.

10″ casing, 694′; 8¼″ casing, 1608′; 6⅝″ casing, 1893′; 5 3/16″ casing, 2803′.

The well was abandoned as dry hole.

The five following records are from one of the richest portions of this great oil belt southeastward from Pedlar and northeastward from Behler. The shot records show that the wells require attention in this respect about every two years, with a gradual increase in the amount of nitro-glycerine used in the charge:

C. E. Johnson No. 5 Well Record (216).

Clay district, 1.1 miles south of Core. Authority, South Penn Oil Company. Completed Sept. 21, 1891.

(Elevation, 1325′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	820	820
Pittsburgh coal	...	820
Unrecorded	1285	2105
Big Injun sand (first pay, 2177′; second, 2186′) and unrecorded to bottom	96	2201

10″ casing, 853′; 8¼″ casing, 1515′; 5⅜″ casing, 2064′.

Shot Aug. 28, 1897, with 5 quarts; Aug. 29, 1899, with 10 quarts; July 31, 1901, with 24 quarts; Feb. 18, 1904, with 40 quarts; and May 3, 1906, with 50 quarts.

The above well had an initial oil production of 150 bbls. daily, but in September, 1911, was making only 1½ bbls. daily.

C. E. Johnson No. 1 Well Record (215).

Clay district, 1.2 miles south of Clay. Authority, South Penn Oil Company. Completed about 1889.

(Elevation, 1340′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded (first oil pay in Injun, 2185′) to bottom	2218	2218

7⅝″ casing, 805′; 4⅞″ casing, 1855′. 4″ liner, 2217′-2153′.

"Initial oil production, 60 bbls. daily, but making only ½ bbl. daily in September, 1911."

C. E. Johnson No. 8 Well Record (214).

Clay district, 0.8 mile southeast of Pedlar. Authority, South Penn Oil Company. Completed in 1906.

(Elevation, 1280′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	330	330
Bluff sand	85	415
Unrecorded	265	680
Coal, Mapletown (Sewickley) and unrecorded	90	770
Coal, Pittsburgh	...	770
Unrecorded	390	1160
Little Dunkard sand	15	1175
Unrecorded	790	1965
Big Lime	98	2063
Big Injun sand (first oil pay, 2062′; second, 2163′) and unrecorded to bottom	117	2180

Although the above well is located in the middle portion of the oil belt, its initial oil production was only 1 bbl. daily, and was making ¼ bbl. daily in September, 1911. Its low

initial output may be due to the gradual exhaustion of the oil pays by other surrounding wells drilled 12 to 15 years previously.

Simon Wildman No. 15 Well Record (213).

Clay district, 1 mile northeast of Behler. Authority, South Penn Oil Company. Completed June 24, 1893.

(Elevation, 1035′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	505	505
Pittsburgh coal	...	505
Unrecorded	1295	1800
Big Injun sand (pay, 1896′) and unrecorded to bottom	126½	1926½

10″ casing, 520′; 8¼″ casing, 800′; 6⅝″ casing, 1520′; 5 3/16″ casing, 300′; 4⅞″ casing, with Masseth Packer, 1516′.

Shot Feb. 9, 1897, with 3 quarts; July 8, 1898, with 10 quarts; and Nov. 29, 1899, with 16 quarts.

D. E. Cordray No. 4 Well Record (212).

Clay district, at Behler. Authority, South Penn Oil Company. Completed Sept. 24, 1895.

(Elevation, 1391′ L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	791	805
Pittsburgh coal	...	805
Unrecorded	1330	2135
Big Injun sand (first pay, show, 2221′; second pay, good, 2239′) and unrecorded to bottom	124	2259

10″ casing, 836′ 8″; 8¼″ casing, 946′ 9″; 6⅝″ casing, 1865′; 5 3/16″ casing, 2145′.

Shot Jan. 30, 1897, with 3 quarts; Mar. 19, 1898, with 10 quarts; May 12, 1900, with 20 quarts; and Mar. 21, 1903, with 30 quarts.

The following is the record of a well on the terrace around the nose of the Mooresville anticline. The driller has erroneously correlated the Sewickley coal with the Pittsburgh bed, since the latter belongs about 1340 feet above the top of the Big Injun sand in this region. Taking into consideration the elevation of the well, structure would place the Pittsburgh seam nearly 100 feet lower.

D. J. Eddy No. 3 Well Record (210).

Clay district, 1 mile southeast of Statler Run. Authority, South Penn Oil Company. Completed Apr. 29, 1892.

(Elevation, 1090′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	445	445
Coal, Pittsburgh (Sewickley)	...	445
Unrecorded	1425	1870
Big Injun sand (first pay, 1926′; second, 1941′) and unrecorded to bottom	86	1956

10″ casing, 558′; 8¼″ casing, 1069′; 6⅝″ casing, 1564′; 5 3/16″ casing, 1850′.

Shot June 19, 1893, with 16 quarts; Aug. 21, 1900, with 20 quarts; Dec., 1902, with 30 quarts; and Apr. 2, 1909, with 40 quarts.

The following is the record of light gasser in the Bayard, which was evidently dry in the Big Injun. It had been abandoned for sometime in 1911:

Daniel Moore No. 2 Well Record (208).

Clay district, 1.3 miles northeast of Statler Run. Authority, Chartiers Oil Company. Completed May 27, 1899.

(Elevation, 1070′ B-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded	572	572
Pittsburgh coal	...	572
Unrecorded (gas, 1282′)	2448	3020
Sand, (Bayard) (gas, 3025½′) and unrecorded to bottom	25½	3045½

Pressure test:

1st minute, 40 lbs. 10th minute, 175 lbs.
5th minute, 105 lbs.

10″ casing, 582′; 8¼″ casing, 864′; 6⅝″ casing, 1630′.

As mentioned on a preceding page, the widest and richest portion of the Big Injun production of the Mt. Morris-Fairview oil belt occurs on the waters of Statler run. The eight following records from wells on the latter stream give interesting data:

Minor Tennant No. 1 Well Record (207).

Clay district, 0.8 mile north of Statler Run. Authority, Chartiers Oil Company. Completed Mar. 31, 1896.

(Elevation, 970′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	480	480
Pittsburgh coal	...	480
Unrecorded	1335	1815
Big Injun sand (oil pay, 1881′-1884′)		

10″ casing, 493′; 8¼″ casing, 835′; 6⅝″ casing, 1485′; 5 3/16″ casing, 1815′.

The above well had an initial oil production of 600 bbls. daily from the Big Injun, and was still making 6 bbls. daily in August, 1911. It is now owned and operated by Hon. Jos. H. McDermott of Morgantown, who, by keeping the shot cavity entirely filled with oil after cleaning out—thus preventing in a large measure the accumulation of paraffine on its walls—has practically doubled the oil production in this and other wells in the immediate neighborhood.

Mary E. Tennant No. 1 Well Record (206).

Clay district, 0.5 mile north of Statler Run. Authority, Jos. McDermott. Completed about 1896.

(Elevation, 985′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	475	475
Pittsburgh coal	...	475
Unrecorded	1321	1796
Big Injun sand (oil pay, 1877′) and unrecorded to bottom.	96	1892

10″ casing, 485′; 8″ casing, 840′; 6″ casing, 1510′.

The above well had an initial oil production of 65 bbls. daily from the Big Injun sand, but was making only 1½ bbls. daily in August, 1911. The oil pay in this region, according to Noah Moore, foreman for J. H. McDermott, comes 85 feet below the top of the sand, and frequently a pay of gas, 10 to 12 feet higher.

Asa Tennant No. 9 Well Record (204).

Clay district at Statler Run P. O. Authority, Hon. Jos. H. McDermott. Completed Nov. 1, 1907.)

(Elevation, 1019′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	493	493
Pittsburgh coal	...	493
Unrecorded	1307	1800
Big Injun sand (oil pay, 1901′) and unrecorded to bottom.	125½	1925½

10″ casing, 507′; 8¼″ casing, 1302′; 6⅝″ casing, 1520′; 5⅜″ casing, 1804′.

"Initial production, 5 bbls. daily, and still making 2 bbls. daily in September, 1911."

According to Noah Moore, foreman, the Big Lime (Greenbrier Limestone) is only 20 to 25 feet thick in this and other wells in the neighborhood.

Mahala McCord Heirs No. 1 Well Record (202).

Clay district, 1.1 miles east of Daybrook. Authority, Chartiers Oil Company.

(Elevation,, 1350' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	905	905
Pittsburgh coal	...	905
Unrecorded	1315	2220
Big Injun sand (small show oil, 2326')	180	2400
Slate and shells	60	2460
Dark gray sand, very hard (Squaw)	30	2490
Light slate and shells	190	2680
Light slate with hard shells in bottom	32	2712
Sand, very dark and hard	17	2729
Slate, light	30	2759
Dark slate and shells	9	2768
Dark gray sand (small gas show) (Berea)	8	2776
Soft slate and shells	19	2795
Sand, very dark and hard	25	2820
Slate, light, soft	12	2832
Sand, dark and hard (Gantz and Fifty-foot)	90	2922
Slate, reddish brown	5	2927
Sand, reddish brown, hard	16	2943
Soft slate and shells	23	2966
Sand, dark, hard (Thirty-foot)	10	2976
Red rock and light shells	14	2990
Sand, bastard, soft dark red	22	3012
Red slate with shells	16	3028
Sand, hard, dark, with soft streaks (Gordon Stray)	21	3049
Light slate with shells	27	3076
Slate, bright red	24	3100
Sand, soft, dark (Gordon)	8	3108
Slate, red, soft, with shells	15	3123
Sand, hard, dark	9	3132
Slate, soft, red	3	3135
Sand, hard, dark gray	9	3144
Slate, soft red	5	3149
Sand, hard, shells and slate..21' / Sand, bastard, dark gray.....27 } (Fourth)	48	3197
Slate, light red	8	3205
Dark sand and shells (Fifth)	40	3245
Hard sand and shells	100	3345
Sand (Bayard), gas at bottom	5	3350
Dark slate and shells to bottom	178	3528

The above well was drilled slightly too far northwest down the structural slope to catch the main oil belt in the Big Injun, but a flow of gas was encountered in the Bayard sand. The **Noah Brewer No. 1 well (203)**, located less than one-fifth mile eastward, had an initial oil production of 30 bbls. daily when completed about November, 1910, and was making 4½ bbls. daily Sept. 1, 1911.

In this region the **Joseph Varner farm** was considered the best in the field, since only one dry hole in 17 wells drilled was obtained, **No. 5 (201)** on this tract starting off Feb. 11, 1895, with an oil production of 750 bbls., and still making 3 bbls. daily in August, 1911.

Enoch Tennant No. 1 Well Record (198).

Clay district, 1.9 miles southwest of Statler Run. Authority, South Penn Oil Company. Completed February 9, 1894.

	Thickness. Feet.	Total. Feet.
Conductor	32	32
Unrecorded	992	1024
Pittsburgh coal	...	1024
Unrecorded	1306	2330
Big Injun sand (first pay, 2417½'; second pay, good, 2422') and unrecorded to bottom	113½	2443½

10" casing, 1053'; 8¼" casing, 826'; 6⅝" casing, 2060', $5\frac{3}{16}$" casing, 2306'.

The above well had a large initial oil production from the Big Injun, and was still pumping on Sept. 1, 1911.

Simeon Tennant No. 12 Well Record (196).

Clay district, 0.9 mile northeast of Sandy. Authority, South Penn Oil Company. Completed Feb. 11, 1895.

(Elevation, 1195' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	15	15
Unrecorded	570	585
Pittsburgh coal	...	585
Unrecorded	1315	1900
Big Injun sand (first pay, 1990½') and unrecorded to bottom	111	2011

Shot Mar. 12, 1897, with 10 quarts; Feb. 25, 1898, with 12 quarts; Nov. 7, 1898, with 20 quarts; Oct. 31, 1899, with 30 quarts; Sept. 20, 1901, with 35 quarts; and January, 1903, with 40 quarts.

The above well had an initial oil production of 240 bbls. daily, but in August, 1911, was making only 7½ bbls. weekly.

Presley Tennant No. 7 Well Record (195).

Clay district, 0.4 mile northeast of Sandy. Authority, South Penn Oil Company. Completed May 27, 1895.

(Elevation, 1165' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	22	22
Unrecorded	555	577

	Thickness. Feet.	Total. Feet.
Pittsburgh coal	...	577
Unrecorded	1323	1900
Big Injun sand (first pay, light, 1960'; second pay, good. 1971') and unrecorded to bottom	87	1987

10" casing, 586'; 8¼" casing, 885'; 6⅝" casing, 1599'; 5⅜" casing, 1860'.

Shot Mar. 26, 1897, with 10 quarts; Mar. 10, 1898, with 12 quarts; Feb. 20, 1899, with 20 quarts; Apr. 25, 1901, with 30 quarts; Mar. 6, 1902, with 40 quarts; June 4, 1904, with 48 quarts; Mar. 16, 1909, with 60 quarts in 3 shells, 4¼"x6' 9".

Top of first shot, 1972'; top of second, 1971'; top of third, 1970'.

Arthela (James) Eddy No. 5 Well Record (189).

Clay district, 0.3 mile southwest of Sandy. Authority, South Penn Oil Company. Completed Sept. 1, 1894.

(Elevation, 1310' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	32	32
Unrecorded	684	716
Pittsburgh coal	...	716
Unrecorded	1215	1931
Big Injun sand (first pay, 2111') and unrecorded to bottom	204	2135

10" casing, 727'; 8¼" casing, 781'; 6⅝" casing, 1762'; 5⅜ casing, 255'.

Shot Apr. 27 1895, with 5 quarts; June 20, 1896, with 4 quarts; May 7, 1897, with 10 quarts; Nov. 7, 1898, with 20 quarts; Oct. 23, 1899, with 30 quarts; May, 1902, with 35 quarts; and Mar. 8, 1907, with two 20 quart shots, top, 2106'.

Southwestward from the divide between the headwaters of Statler and Days runs to the Monongalia-Marion county line, many of the wells have produced oil from both the Big Injun and Bayard sands. The following records give much data of interest concernig both horizons:

E. J. Ammons Heirs No. 7 Well Record (193).

Clay district 2 miles south of Daybrook. Authority, Delmar Oil Company. Completed Apr. 10, 1906.

(Elevation, 1160' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	8	8
Unrecorded	670	678
Pittsburgh coal	6	684
Unrecorded	1296	1980
Big Injun sand	160	2140
Unrecorded	770	2910
Fourth sand	30	2940

	Thickness. Feet.	Total. Feet.
Unrecorded	141	3081
Sand (Bayard) (oil and gas, 3082')	7	3088
Unrecorded to bottom	5	3093

13" casing, 116'; 10" casing, 690'; 8¼" casing, 978'; 6⅝" casing, 1664'; 5⅛" casing, 1950'.

Daniel L. Toothman No. 12 Well Record (191).

Clay district, 1.5 miles N 85° W of Sandy. Authority, South Penn Oil Company. Completed Aug. 16, 1904.

(Elevation, 1660' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	1229	1243
Pittsburgh coal	8	1251
Unrecorded	514	1765
Dunkard sand	40	1805
Unrecorded	325	2130
Salt sand	140	2270
Unrecorded	150	2420
Maxton sand	15	2435
Unrecorded	55	2490
Big Lime	60	2550
Big Injun sand (gas, 2640'; first oil pay, 2640'; second, 2658')	130	2680
Unrecorded	460	3140
Sand, (Gantz and Fifty-foot)	170	3310
Unrecorded	130	3440
Gordon sand	50	3490
Unrecorded	10	3500
Fourth sand	25	3525
Unrecorded	138	3663
Fifth sand (oil pay, 3663')	8	3671
Unrecorded to bottom	28	3699

10" casing, 1270'; 8¼" casing, 1610'; 6⅝" casing, 2265'; 5⅛" casing, 2670'; 4" casing, 420'.

Shot Sept. 10, 1904, with 20 quarts in 10' shell in Fifth (Bayard) sand. Lined with 4" liner at 3648'. Drilled to Injun sand May, 1910. First plug (3, ½" x 4, ⅞") driven to 3215' and filled up 120' with rock and sediment. Second plug (3, ½" x 4, ⅞") driven on top, that is, 3095' and filled up 30' with rock. Third plug (pole 8' long) driven to 2745' and filled up 60' with rock. 5⅛" casing put back with Heeter wall packer set in Big Lime at 2522'.

The above well is probably the deepest oil producer in the Appalachian field, being 68 feet deeper than Wilson Heirs No. 9 in the same region, given as the deepest producing oil well on page 141 of Vol. I(A) of the State Survey reports to the date of the latter's publication, and 41 feet deeper than Wilson Heirs No. 11 (182), located 2 miles north of Fair-

view, completed in 1905 and given as the deepest producing oil well in the world in Bulletin 298 of the U. S. Geological Survey, pp. 292-293. The log of the latter well is also published on the pages last mentioned, and thereon is shown to have had an initial oil production of 12 barrels daily from the Bayard, erroneously called the Fifth sand, along with an oil showing in both the Big Injun and Fifty-foot.

M. A. Ammons No. 3 Well Record (185).

Clay district, 1.6 miles southwest of Sandy. Authority, South Penn Oil Company. Completed Sept. 10, 1893.

(Elevation, 1082' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	559	575
Pittsburgh coal	..	575
Unrecorded	1310	1885
Big Injun sand (oil pay, 1982', 1991') and unrecorded to bottom	127	2012

10" casing, 616'; 8¼" casing, 804' 2"; 6⅝" casing, 1607; 5⅜" casing, 275'.

Shot Aug. 23, 1895, with 12 quarts; Oct. 27, 1897, with 24 quarts; Mar. 11, 1899, with 30 quarts; and July 2, 1907, with 40 quarts. Top of 30 quart shell, 1988'; top of 10 quart shell, 1980'.

C. M. Toothman No. 4 Well Record (183).

Clay district, 1.5 miles north of Fairview. Authority, Fisher Oil Company. Completed Dec. 14, 1903.

(Elevation, 1055' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	10	10
Unrecorded	560	570
Pittsburgh coal	8	578
Unrecorded	1317	1895
Big Injun sand (pay, 1969'-1973')	120	2015
Unrecorded	765	2780
Gordon sand	20	2800
Unrecorded	30	2830
Fourth sand	30	2860
Unrecorded	121	2981
Bayard sand (pay, 2981'-2985')	4	2985
Unrecorded to bottom	18	3003

10" casing, 580'; 8¼" casing, 1075'; 6⅝" casing, 1560'; 5⅜" casing, 1985'.

"4" liner, 535', in two sections, 271 feet in first, and 252' in second, bottom joint perforated. Filled up 800' with oil and water from Injun pay. Filled up 1200' with oil from Bayard sand, the first 12 hours no gas at all. Bottom hole packed put in with 5⅜" casing. Shot Mar. 26, 1904 with 24 quarts nitro-glycerine; depth before being

shot 2981', after shot 2997'. Making 2 bbls. daily from Bayard when water broke in from Big Injun in June, 1911, temporarily drowning out the well."

The C. M. Toothman No. 1 well (184), located 1.3 miles north of Fairview, had an initial oil production of 30 barrels when completed in 1902, and was still making 3 barrels daily in August, 1911.

W. R. Shuman No. 4 Well Record (181).

Clay district, 2.2 miles N 50° E of Fairview. Authority, South Penn Oil Company. Completed October 9, 1903.

(Elevation, 1335' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	918	932
Pittsburgh coal	..	932
Unrecorded	1300	2232
Big Injun sand (water, 2332') and unrecorded	650	2882
Fifty-foot sand and unrecorded	260	3142
Gordon sand and unrecorded	209	3351
Sand (Bayard) (first pay, light, 3351') and unrecorded to bottom	31	3382

13¼" casing, 98'; 10" casing, 946'; 8¼" casing, 1396'; 6⅝" casing, 1940'; 5$\frac{3}{16}$" casing, 2345'; 4½" casing, 471'.

Shot Dec. 22, 1903, with 20 quarts; Feb. 24, 1909, with 40 quarts, 4¼" x 6' 9" shell. Top of first shell, 3352'; top of second, 3351'.

E. B. Toothman No. 1 Well Record (180).

Clay district, 1.8 miles north of Fairview. Authority, Pure Oil Company. Completed Oct. 22, 1903.

(Elevation, 1110' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	676	676
Pittsburgh coal	..	676
Unrecorded	1300	1976
Big Injun sand (pay, 2081'-2086')	138	2114
Unrecorded to bottom	1	2115

"Plugged off (Bayard) sand in August, 1906. First plug, 2165'. Stone and sand to 2135'; ½ barrel cement. Wall packer on bottom of 5$\frac{3}{16}$" casing."

The above well was drilled on down to the Bayard, having an initial oil production of 10 to 15 barrels from this sand and 10 to 15 barrels in the Big Injun. It was still making 6 barrels from the latter sand in August, 1911.

On Days run, 1.7 miles northward from the above well,

there occurs a small oil producer in the Bayard sand; viz., David L. Ammons No. 1 (192), drilled in, about 1903. It had an initial oil production of 5 barrels daily, and was making 3 barrels daily in August, 1911.

Along the southeast edge of Clay district there are several gas wells on the head of Dolls run in which the Big Injun, Gantz and Fifth sands are the producing horizons. The two following records therefrom give the detailed rock succession and other data of interest:

Martha A. Miller No. 1 Well Record (230).

Clay district, 2.2 miles northeast of Hagans. Authority, West Virginia Traction & Electric Company.

(Elevation, 1225' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	18	18
Slate and shale	40	58
Lime	7	65
Slate and shale	50	115
Lime shells	20	135
Slate	25	160
Slate and sand shale	50	210
Mt. Morris (Waynesburg) coal	6	216
Slate and shale	37	253
Lime	11	264
Slate	24	288
Lime shells	23	311
Slate	17	328
Sand	15	343
Slate and shale	22	365
Lime	11	376
Slate and shale	19	395
Lime	26	421
Slate	16	437
Lime	7	444
Slate	18	462
Lime	16	478
Slate	10	488
Mapletown (Sewickley) coal	6	494
Slate and shale	32	526
Lime	12	538
Slate	14	552
Lime	18	570
Slate	7	577
Pittsburgh coal	8	585
Slate	12	597
Sand, (Lower Pittsburgh)	39	636
Slate and shale	40	676
Sand, (Minshall)	20	696
Slate	74	770

	Thickness. Feet.	Total. Feet.
Sand, (Murphy)	35	805
Lime shales	50	855
Sand, (Grafton)	35	890
Sandy lime	25	915
Red rock	5	920
Slate	20	940
Sand, (Saltsburg)	15	955
Slate and shale	90	1045
Limy sand	25	1070
Slate	30	1100
Red rock	15	1115
Slate and shale	75	1190
Big Dunkard sand	35	1225
Lime	25	1250
Sand	20	1270
Slate	25	1295
Sand	5	1300
Slate and shale	30	1330
Sand	12	1345
Slate	25	1370
Sand	25	1395
Slate	32	1427
Salt sand	80	1507
Slate	28	1535
Sand	35	1570
Black slate	10	1580
Limy sand	19	1599
Slate	45	1644
Limy sand	40	1684
Slate	20	1704
Red rock	28	1732
Limy sand	17	1749
Slate	11	1760
Red rock	14	1774
Slate	12	1786
Limy sand	9	1795
Slate	5	1800
Big Lime	60	1860
Big Injun sand (gas pay, 1941')	139	1999
Slate	63	2062
Squaw sand	36	2098
Slate and shale	193	2291
Sand	9	2300
Slate and shale	100	2400
Sand, (Berea)	34	2434
Slate	11	2445
Slate and shale	38	2483
Limy sand	68	2551
Red rock	4	2555
Slate and shale	285	2840
Sand, (Fourth)	15	2855
Slate	45	2900
Fifth sand and unrecorded to bottom	29	2929

6⅝" casing, 1590'.

J. C. and R. Morris Well Record (224).

Clay district, 2 miles S 15° E of Core. Authority, South Penn Oil Company. Completed Aug. 3, 1911.

(Elevation, 1205′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	486	500
Coal, Mapletown (Sewickley)	..	500
Unrecorded	90	590
Coal, Pittsburgh	..	590
Unrecorded	900	1490
Salt sand (water, 1495′)	140	1630
Unrecorded	55	1685
Maxton sand	30	1715
Unrecorded	107	1822
Big Lime	73	1895
Big Injun sand (gas, 1½ million cu. ft., at 1983′; ⅝ mercury in 5″ pipe)	140	2035
Unrecorded	75	2110
Sand, (Squaw)	40	2150
Unrecorded	285	2435
Sand, (Gantz) (gas, 4,200,000 cu. ft., at 2498′; 14/10 mercury in 5″ pipe)	75	2510
Unrecorded	188	2708
Gordon Stray sand	1	2709
Gordon sand (gas, 2714′)	9	2718
Unrecorded	152	2870
Fourth sand	30	2900
Unrecorded	39	2939
Fifth sand	7	2946
Unrecorded to bottom (little oil 2948′; little oil, 2986′)	94	3040

10″ casing, 604′; 8¼″ casing, 1508′; 6⅝″ casing, 1839′; 5⅜″ casing, 2732′; 4″ casing, 197′.

Shot Aug. 7, 1911, with 20 quarts; Aug. 9, 1911, with 20 quarts.

The gage tests given above for the Big Injun and Gantz sands are equivalent to a production of 4,200,000 and 1,500,000 cubic feet of gas daily, respectively. A fair showing of oil was encountered in the Fifth sand. The **Margaret Davis No. 1 well (225)**, located 0.4 mile southward from the last mentioned well, and drilled during 1911, had a 15 barrel initial oil production from the Fifth sand in addition to a good pay of gas.

According to Hon. E. M. Grant, Morgantown, W. Va., the **Thornton Miller Heirs No. 1 well (228)**, located on the head of Dolls run and drilled in 1890, had an initial gas production of 5,000,000 cu. ft. daily from the Big Injun with a rock pressure of 500 pounds.

The **Aaron Hawkins No. 1 well (231)**, located 1.3 miles northeast of Hagans, had a light gas pay in the Big Injun sand, but was abandoned as a dry hole. It was not drilled below the Big Injun.

Southwestward in the vicinity of Hagans the West Virginia Traction & Electric Company drilled in two Big Injun gassers; viz., Cal Halwkins No. 1 (232) and M. A. Miller No. 2 (233). During 1912 the Hope Natural Gas Company drilled a well in the north edge of Hagans on down through the Fifth sand and obtained a 10-barrel oil well at the latter horizon, the log of which is given next below:

D. F. Morris No. 2618 Well Record (234A).

Clay district, at Hagans. Authority, Hon. Jos. H. McDermott. Completed Aug. 17, 1912.

	Thickness. Feet.	Total. Feet.
Unrecorded	135	135
Coal, native, (Waynesburg)	4	139
Unrecorded	286	425
Coal, Mapletown (Sewickley)	5	430
Unrecorded	80	510
Coal, Pittsburgh (steel line measurement)	5	515
Unrecorded	345	860
Sand, (Saltsburg) and unrecorded	130	990
Sand, Big Dunkard, and unrecorded	175	1165
Gas sand	35	1200
Unrecorded	98	1298
Sand, (II Cow Run)	38	1336
Unrecorded	59	1395
Salt sand (water, at 1470)')	138	1533
Unrecorded	67	1600
Sand	20	1620
Unrecorded	110	1730
Little Lime	9	1739
Pencil cave	6	1745
Big Lime	55	1800
Big Injun sand (gas, 1898'; 4/10" water in 2" opening)	130	1930
Unrecorded	5	1935
Sand, Squaw?	10	1945
Unrecorded	90	2035
Sand, (Squaw)	40	2075
Unrecorded	170	2245
Sand, (Berea)	20	2265
Unrecorded	70	2335
Sand, (Gantz)	55	2380
Unrecorded	15	2395

	Thickness. Feet.	Total. Feet.
Sand, Fifty-foot .....25'		
Unrecorded .....15 } (Fifty-foot)	60	2455
Sand 20		
Unrecorded	15	2470
Sand, Thirty-foot	60	2530
Unrecorded	81	2611
Sand, Gordon Stray (steel line measurement).....	8	2619
Unrecorded	10	2629
Sand, Gordon (steel line)..29'		
Unrecorded ..... 7 } (Gordon)	43	2672
Sand 7		
Unrecorded	113	2785
Sand, Fourth.....	13	2798
Unrecorded	43	2841
Sand, Fifth (oil at 2848') (steel line).....	49	2890
Unrecorded to bottom.....	22	2912

10" casing, 571'; 8¼" casing, 1531'; 6⅝" casing, 1795'; and 5⅓" casing, 2616'.

"Shot to test for oil with 15 quarts nitro-glycerine on Aug. 8, 1912; top of shell, 2848'.

"Cementing record on June 25, 1912:

Size of hole cemented, 16 inch. Amt. of cement used, 5,000 lbs.

Size of casing cemented, 10-inch. Amt. of sand used, 10,000 lbs.

Top of cementing at 395'.

Bottom of cementing at 570'.

The above well had an initial oil production of 10 bbls. daily from the Fifth sand, and the gage test for the Big Injun sand is equivalent to about 100,000 cubic feet daily.

Three practically dry holes were drilled immediately north and northwest of McCurdyville on the H. P. Wilson (236), Jacob A. Eddy (237) and Isaac S. Eddy (238) farms, a light showing of gas being encountered in the latter in the Big Injun. The Hope obtained a gasser at the same horizon on the Newton Varner farm (235), 1 mile northeast of McCurdyville. Passing westward along the southern edge of Clay to the heads of Robinson and Laurel runs there occur some Big Injun gas wells on the John T. Neely (187) and C. W. Yost (186) farms, respectively.

Prospective Oil and Gas Areas, Clay District.—This district, like Battelle, has been quite thoroughly tested for oil and gas, yet there remain a few small areas that would justify further drilling. Taking up these areas from west to east, (1) that, along the Big Injun oil belt in the northwestern corner

of the district, lying southwestward from the Jas. Lemley Heirs No. 1 (153) and Asa Lemley No. 3 (154) to the S. D. Lemley No. 2 (156) and the J. N. Wilson No. 1 (157); (2) that, northeastward from the David L. Ammons No. 1 well (192) along the west side of Days run in the Whiteley Basin to near Pentress, appears favorable from a structural standpoint for Bayard sand oil, although the last mentioned well was very light in its oil production from this sand; (3) that, immediately southward along the crest of the Mooresville anticline to near the head of Long Drain, for gas in the sands below the Big Injun; (4) that, northwest of Hagans to the low gap at the head of Little Pawpaw creek, for Big Injun gas; (5) that, south and southwestward from Hagans to the Monongalia-Marion county line for gas in the Big Injun and oil in the Fifth; (6) that, for 1 mile northward and 2 miles north 20° to 45° eastward from Hagans for oil in the Fifth; and (7) that, for 1 mile northeastward from the J. C. Morris No. 1 (224) and Margaret Morris No. 1 (225) wells for oil or gas in the Fifth sand.

Cass District

Cass district, Monongalia county, lies immediately east of Clay district, west of the Monongahela river and south of Greene county, Penna. Its entire area lies along the western slope of the Indiana anticline. Although its strata are not so warped and twisted as that for Battelle and Clay districts, yet considerable relief prevails, the Pittsburgh coal rising from an elevation of about 420′ A. T. near Holman in the extreme northwest point of the district, to almost 1200′ A. T., northeastward from VanVoorhis. Along the east and west borders of Cass the rocks dip quite rapidly to the northwest, but in the middle portion there is a slight structural terrace —1 to 2 miles wide—extending from the State line southwestward to Cassville, between the 725 and the 800-foot contours of the Pittsburgh coal as outlined on Map II. The Mt. Morris-Fairview Big Injun sand oil belt extends in a northeast-southwest direction entirely across the northwest corner of Cass. Southeastward up the structural slope from this oil pool there are 60 to 70 gas wells from the same sand within

the boundaries of the district. A large number of these wells are on the structural terrace mentioned above.

No wells have ever been drilled in that portion of Cass northwest of the Big Injun oil pool mentioned above for the reason that heavy doses of salt water are encountered in that sand as the axis of the Lambert syncline is approached from the oil field.

Fifty to sixty producing oil wells have been drilled along the Big Injun sand oil belt above mentioned, which has an average width of about one-half mile. The two following records from wells in this field, although very meagre, give some data of interest:

W. P. Core No. 9 Well Record (241)

Cass district, 1.4 miles S 10° W of Mt. Morris. Authority, South Penn Oil Company. Completed Nov. 28, 1899.

	Thickness. Feet.	Total. Feet.
Conductor	13	13
Unrecorded	519	532
Pittsburgh coal	..	532
Unrecorded	1308	1840
Big Injun sand (gas, 1895'; first oil pay, 1916') and unrecorded to bottom	100	1940

10" casing, 532'; 8¼" casing, 1431' 10"; 6⅝" casing, 1418' 9"; 5⅛" casing, 1846' 3".

Shot Jan. 31, 1900, with 10 quarts; Feb. 14, 1901, with 24 quarts; Jan. 2, 1902, with 30 quarts; and Jan. 21, 1905, with 30 quarts.

C. C. Core No. 2 Well Record (239A).

Clay district, 1.3 miles northeast of Core. Authority, South Penn Oil Company. Completed Oct. 18, 1891.

(Elevation, 1355' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	805	805
Pittsburgh coal	..	805
Unrecorded	1283	2088
Big Injun sand (first pay, 2175'; second, 2197') and unrecorded to bottom	147	2235

8¼" casing, 1120'; 6⅝" casing, 1680'; 5⅛" casing, 2040'.

Shot Mar. 17, 1899, with 5 quarts; July 1, 1899, with 16 quarts; and July 23, 1904, with 24 quarts in second pay.

The Asa Sutton No. 1 well (239), located on the west edge of the oil belt, 1.6 miles northeast of Core, and drilled

about 22 years ago, had an initial oil production of 45 bbls. daily from the Big Injun, but had been abandoned in 1911.

The first well drilled in Cass district, according to Hon. E. M. Grant of Morgantown, was the **Almeda Dorsey No. 1 well (242)**, located 1.5 miles S 10° E of Mt. Morris and completed in the summer of 1888 by the Union Improvement Company. Its initial volume was estimated at 10,000,000 cubic feet, and was the first well connected up to supply Morgantown with gas.

One to two miles east of this Big Injun oil belt there occurs a pool of 20 to 25 gas wells from the same sand along the structural terrace above mentioned. The following records from this field are of special interest for the information they contain concerning the several coals and the depth and volume of the gas pays:

Bowen Wade No. 2 Well Record (250).

Dunkard township, Greene county, Pa., 0.9 mile N 20° E of Bowlby. Authority, Randall Gas & Water Company. Completed Sept. 9, 1910.

(Elevation, 1190′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	55	55
Coal, Hill (Waynesburg)	9	64
Unrecorded	26	90
Coal, (Little Waynesburg)	2	92
Unrecorded	228	320
Mapletown (Sewickley) coal	5	325
Unrecorded	57	382
Coal, Redstone	4	386
Unrecorded	27	413
Coal, Pittsburgh	10	423
Unrecorded	763	1186
Salt sand (water, 1385′)	245	1431
Unrecorded	204	1635
Big Lime	105	1740
Big Injun sand (gas, 1844′ and 1865′) to bottom	140	1880

10″ casing, 444′; 8¼″ casing, 1391′; 6⅝″ casing, 1452′.

"Pressure in 6⅝″ casing.

First minute, 65 lbs. Rock pressure, 105 lbs."

Iona Bowlby No. 3 Well Record (251).

Cass district, 0.5 mile northwest of Bowlby. Authority, West Virginia Traction and Electric Company. Completed June 30, 1908.

(Elevation, 1130′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	15	15
Lime	4	19
Slate	2	21
Sand	14	35
Slate shale	25	60
Lime	6	66
Slate and shale	15	81
Lime	5	86
Slate	24	110
Lime	8	118
Slate	12	130
Sand	10	140
Slate	8	148
Lime	18	166
Slate	17	183
Lime	9	192
Slate	12	204
Lime	11	215
Slate	7	222
Lime	8	230
Slate and shale	17	247
Lime	19	266
Slate	10	276
Coal, (Sewickley)	6	282
Slate	24	306
Lime	7	313
Slate shale	12	325
Lime	20	345
Slate shale	16	361
Coal, (Redstone)	5	366
Slate	10	376
Coal, Pittsburgh	8	384
Lime	11	395
Shale	90	485
Red rock	15	500
Slate and shale	51	551
Sand, (Morgantown)	53	604
Slate and shale	66	670
Red rock ("Pittsburgh Reds")	26	696
Limy sand	9	705
Slate and shale	65	770
Lime sand	11	781
Slate	15	796
Red rock	12	808
Slate	25	833
Sandy lime	16	849
Slate	34	883
Sand, (Big Dunkard)	38	921
Slate	31	952

	Thickness. Feet.	Total. Feet.
Sand	18	970
Slate	8	978
Sand	17	995
Slate	25	1020
Sand	21	1041
Coal, (Lower Freeport)	4	1045
Slate and shale	20	1065
White sand, (Lower Freeport)	55	1120
Black slate	10	1130
Limy sand	18	1148
Slate and shale	29	1177
Limy sand	22	1199
Slate	28	1227
Sand (II Cow Run)	65	1292
Black slate	14	1306
Sand	16	1322
Slate and shale	45	1367
Sand, (Salt)	85	1452
Slate and shale	20	1472
Red rock	40	1512
Sandy lime	15	1527
Red rock	20	1547
Lime	10	1557
Slate	7	1564
Lime	15	1579
Slate break	5	1584
Big Lime	70	1654
Unrecorded	1	1655

Big Injun sand (gas).

"Pressure, first minute, 25 lbs. in $5\frac{3}{16}$" pipe."

The **Sanford Wade No. 1 well (253)**, located 1.1 miles N 80° W of Bowlby and completed in 1890, was the heaviest gasser, according to E. M. Grant, drilled in this field, having an initial rock pressure of 550 pounds and a volume estimated at 15 to 20 million cu. ft. of gas daily. The well blew into the air for the first 6 months, and owing to the weakness of the casing used, could not be shut in entirely until two years after completion. It was the second gas well drilled in Cass district and was connected up with the Union Improvement Company's line to Morgantown.

Spencer Cunningham No. 1 Well Record (254)

Cass district, 1.2 miles west of Bowlby. Authority, West Virginia Traction & Electric Company. Completed Jan. 12, 1907.

(Elevation, 1195' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	145	145
Mt. Morris (Waynesburg) coal	5	150
Unrecorded	285	435
Mapletown (Sewickley) coal	5	440
Unrecorded	80	520
Pittsburgh coal	10	530
Unrecorded	1296	1826
Big Injun sand (small gas, 1829'; gas, 1903' and 1918') and unrecorded to bottom	137	1963

8" casing, 134'; 5 3/16" casing, 1826'; 3" tubing, 1827'.

"Rock pressure, 160 lbs.; mercury test, 1.06 inches in 4" tubing; Volume, 2,200.000 cu. ft. daily."

Iona Bowlby No. 4 Well Record (255).

Cass district, 0.6 mile S., 80° W. of Bowlby. Authority, West Virginia Traction & Electric Company. Completed Sept. 26, 1908.

(Elevation, 1220' B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Slate	22	36
Sand	63	99
Mt. Morris (Waynesburg) coal	6	105
Slate, shale and lime in alternate layers	267	372
Coal, (Sewickley)	6	378
Slate	21	399
Sand	16	415
Shale	22	437
Lime	20	457
Slate	5	462
Slate and coal (Pittsburgh)	10	472
Lime shales and sand in layers (no coal)	472	1022
Sand, Big Dunkard	90	1112
Sandy shales	33	1145
"Gas" sand (gas)	85	1230
Slate shales	20	1250
Unrecorded to bottom	151	1401

10" casing, 480'; 8" casing, 1040'.

The above well is a gasser in the "Gas" sand and was not drilled to the Big Injun.

Geo. Weaver No. 1 Well Record (258).

Cass district, 1.8 miles S., 80° W. of Bowlby. Authority, West Virginia Traction & Electric Company. Completed January, 1900.

(Elevation, 1180′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	444	444
Pittsburgh coal	..	444
Unrecorded	1310	1754
Big Injun sand (first pay, 1806′; second, 1844′)		

"Open flow, mercury test, 1.00 in 3" pipe, May 16, 1907."

The above gage test is equivalent, 1,240,000 cu. ft. of gas daily. According to E. M. Grant, its initial volume was 3 to 4 million cu. ft. daily, and rock pressure, 300 pounds.

Wm. McCormick No. 2 Well Record (259).

Cass district, 1.5 miles southwest of Bowlby. Authority, West Virginia Traction & Electric Company. Completed Mar. 12, 1909.

(Elevation, 1245′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	15	15
Slate	9	24
Bluff sand	71	95
Slate	5	100
Mt. Morris (Waynesburg) coal	8	108
Slate and unrecorded	267	375
Mapletown (Sewickley) coal	5	380
Slate and shale	30	410
Lime	11	421
Slate and shale	19	440
Lime	18	458
Black slate	8	466
Pittsburgh coal	8	474
Slate, shale and sand, with no coal	1125	1599
Lime	18	1617
Slate	7	1624
Big Lime	68	1692
Big Injun sand (first pay, 1883′) and unrecorded to bottom	240	1932

"Driller's record shows difference of 92′."

10" casing, 500′; 8" casing, 1247′; 6½" casing, 1532′.. 5 3/16" casing, 1802′.

The detailed record between the Sewickley and Pittsburgh coals is given to show the absence of Redstone coal immediately to the west of a region where it frequently attains minable thickness.

Frank McCormick No. 1 Well Record (260).

Cass district, 1.4 miles southwest of Bowlby. Authority, West Virginia Traction & Electric Company.

(Elevation, 1215′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	7	7
Bluff sand	58	65
Mt. Morris (Waynesburg) coal	5	70
Slate, shale and sand in layers.	280	350
Mapletown (Sewickley) coal	6	356
Slate	16	372
Lime	15	387
Slate	11	398
Lime	17	415
Slate	8	423
Pittsburgh coal	8	431
Slate, red rock, lime and sand in layers, no coal	1208	1639
Lime	18	1657
Black slate	7	1664
Big Lime	84	1748
Big Injun sand (first pay, 1848′; second, 1863′)	134	1882

The following is the record of a gasser in both the Big Injun and Berea sands. It was drilled on down through the Bayard.

Mark Weaver No. 1 Well Record (262).

Cass district, 1.9 miles southwest of Bowlby. Authority, West Virginia Traction & Electric Company. Completed July 2, 1909.

(Elevation, 1130′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Slate	16	30
Sand, (Waynesburg.)	60	90
Slate	10	100
Mt. Morris (Waynesburg) coal	8	108
Slate, shale and lime, no coal	277	385
Mapletown (Sewickley) coal	5	390
Slate and shale	28	418
Lime	13	431
Slate	17	448
Lime	17	465
Slate	12	477
Pittsburgh coal	8	485
Slate, shale, red rock, with alternate layers of sand and shale	1215	1700
Lime	14	1714
Slate	11	1725
Big Lime	61	1786
Big Injun sand (red break, 1796′; first gas pay, 1875′; second, 1890′)	165	1951

	Thickness. Feet.	Total. Feet.
Slate and shale	34	1985
Sand shales (Squaw)	44	2029
Slate and shale mixed	303	2332
Sand, (Berea) (gas pay, 2350'.)	53	2385
Black slate	12	2397
Sand	37	2434
Red shale	44	2478
Slate and shale	39	2517
Red rock	30	2547
Slate	17	2564
Lime shales	26	2590
Red lime shales	30	2620
Limy sand (Gordon Stray)	35	2655
Slate and shale	40	2695
Limy sand (Gordon)	28	2723
Slate	36	2759
Sand, (Fourth)	23	2782
Slate	34	2816
Sand, (Fifth)	36	2852
Slate and shale	43	2895
Sand, (Bayard)	68	2963
Slate and shale to bottom	30	2993

10″ casing, 507′; 8″ casing, 1153′; 6½″ casing, 1510′; 5″ casing, 1786′.

The driller evidently made no attempt to correlate the sands below the Big Injun, but the names in parentheses, inserted by the writer, approximate closely the formation indicated.

Justus Brewer No. 1 Well Record (263).

Cass district, 2.2 miles northeast of Cassville. Authority, West Virginia Traction & Electric Company. Completed Mar. 15, 1908.

(Elevation, 1000′ -B.-A. T.)	Thickness. Feet.	Total. Feet.
Slate, lime and shells	130	130
Mapletown (Sewickley) coal	6	136
Slate and shale	20	156
Lime	13	169
Slate	17	186
Lime	23	209
Black slate	11	220
Pittsburgh coal	10	230
Slate, shale, red rock and sand, with no coal	1210	1440
Lime	12	1452
Slate	8	1460
Big Lime	60	1520
Sandy Lime	22	1542
Big Injun sand (first pay, 1648′; second, 1666′)	145	1687
Slate and shale	148	1835
Sand, (Squaw)	40	1875

	Thickness. Feet.	Total. Feet.
Slate and shale	258	2133
Sand, (Gantz)	25	2158
Slate	14	2172
Sand slate (Fifty-foot)	100	2272
Red rock	28	2300
Limy sand	8	2308
Slate and shale	14	2322
Limy sand	8	2330
Shale and red rock	90	2420
Sand shales (Stray)	35	2455
Slate	30	2485
Sand shales, (Gordon)	26	2511
Slate and shale	40	2551
Sand shales (Fourth)	20	2571
Slate	14	2585
Sand (Fifth)	22	2607
Slate	26	2633
Sand, (Bayard) (oil show, 2690')	76	2709
Slate to bottom	11	2720

10" casing, 371'; 8" casing, 1213'; 6" casing, 1295'; 5" casing, 1544'.

Southwestward along the structural terrace heretofore mentioned there are several gas wells in the southern edge of Cass district both east and west of Cassville. The two following records are from wells in this field in which both the Big Injun and Fifth sands appear productive:

Wm. Higgins No. 1 Well Record (266).

Cass district, 0.8 mile east of Cassville. Authority, West Virginia Traction & Electric Company. Completed July 5, 1910.

(Elevation, 955' B.-A. T.)	Thickness. Feet.	Total. Feet.
Slate and lime	82	82
Mapletown (Sewickley) coal	5	87
Slate and shale	12	99
Lime	9	108
Slate and shale	20	128
Lime	11	139
Slate	18	157
Lime	12	169
Slate	9	178
Pittsburgh coal	8	186
Slate, shale, lime and sand in alternate layers, no coal	1258	1444
Pig Lime	60	1504
Big Injun sand (first pay, 1613'; second, 1631') and unrecorded to bottom	132	1636

10" casing, 230'; 8" casing, 1045'; 6" casing, 1504'.

Chas. E. Core No. 1 Well Record (270).

Cass district, 1.2 miles southwest of Cassville. Authority, West Virginia Traction & Electric Company. Completed September, 1902.

(Elevation, 1165' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	470	470
Pittsburgh coal	..	470
Unrecorded	1280	1750
Big Injun sand (gas pay, 1837', 1846' and 1861') and unrecorded to bottom	141	1891

5 3/16" casing, 1770'; 3" tubing, 1500'.

"3.04 inches mercury on open flow in 2" pipe, May 15, 1907. Volume, 991,000 cu. ft. of gas daily."

The detailed log of **David Henderson No. 1 well (269)** is published in connection with the Cassville section, page 100. It is a gasser from both the Big Injun and Fifth sands.

The **Amasa Cole No. 1 well (268A)**, located 0.6 mile west of Cassville and completed by E. M. Hukill & Company in 1889, was the first gas well drilled this far south in Cass district, according to E. M. Grant. It had an initial volume of 5,000,000 cu. ft. daily and a rock pressure of 500 pounds.

The **Jas. Kennedy No. 1 well (264A)**, located 1.6 miles east of Cassville, made several barrels of oil from the Bayard sand—2450 feet below the Pittsburgh coal—showing for 2 to 3 barrels daily, but it was abandoned as non-paying in a few days after completion. A light gas pay was encountered in the Big Injun.

In the northeastern portion of Cass district there are 35 to 40 gas wells on the waters of Robinson run in the vicinity of Maidsville, in which the Big Injun is the main producing sand. The 10 following records from wells in this field, none of which was drilled below the Big Injun to the deep sands, show the presence of apparently minable coal in the Allegheny series in addition to four minable beds in the Monongahela measures, as well as interesting gas pressure tests. The Pittsburgh coal—Big Injun sand interval averages about 1325 feet.

John Laird (E. Roach) No. 1 Well Record (272).

Cass district, 1.4 miles S., 80° W. of Maidsville. Authority, West Virginia Traction & Electric Company. Completed Sept. 21, 1911.

(Elevation, 1135′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	9	9
Unrecorded	178	187
Mapletown (Sewickley) coal	5	192
Unrecorded	58	250
Redstone coal	2	252
Unrecorded	24	276
Pittsburgh coal	10	286
Unrecorded	483	769
Little Dunkard sand	47	816
Unrecorded	41	857
Big Dunkard sand	57	914
Unrecorded	57	971
Coal, Freeport? (Upper Kittanning)	5	976
Unrecorded	27	1003
Gas sand	18	1021
Coal, (Lower Kittanning)	6	1027
Unrecorded	80	1107
Sand, (II Cow Run)	20	1127
Coal, (gas) (Tionesta)	3	1130
Slate	7	1137
Second Salt sand (water)	151	1288
Unrecorded	133	1421
Little Lime	35	1456
Pencil cave	28	1484
Unrecorded	36	1520
Big Lime	76	1596
Big Injun sand (break, 1614′-1616′; gas, 1685′; sand broken)	157	1753
Unrecorded to bottom	26..	1779

10″ casing, 355′; 8″ casing, 1195′; 6″ casing, 1340′; 5″ casing, 1614′.

Elza Davis No. 1 Well Record (273).

Cass district, 1.1 miles west of Maidsville. Authority, West Virginia Traction & Electric Company. Completed June 20, 1911.

(Elevation, 1050′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	19	19
Slate	52	71
Mapletown (Sewickley) coal	5	76
Lime	59	135
Slate	12	147
Redstone coal	5	152
Lime	18	170
Slate	8	178
Pittsburgh coal	11	189
Slate, lime shales, sand in layers, without coal	691	880
Coal, (Upper Kittanning)	5	885

	Thickness. Feet.	Total. Feet.
Lime	25	910
Slate and shales	28	938
Gas sand (gas and water)	23	961
Slate, sand, shell, reds and lime, no coal	455	1416
Big Lime	82	1498
Big Injun sand (first gas pay, 1509′; second, 1583′; third, 1593′; fourth, 1600′) and unrecorded to bottom	137	1635

5 3/16″ casing, 1498′.

Wm. H. Smith No. 1 Well Record (274).

Cass district, 1.1 miles west of Cassville. Authority, West Virginia Traction & Electric Company. Completed April 22, 1911.

(Elevation, 1155′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	174	190
Mapletown (Sewickley) coal	5	195
Unrecorded	101	296
Pittsburgh coal	11	307
Unrecorded	659	966
Coal, Upper Freeport? (Lower Freeport)	6	972
Unrecorded	26	998
Coal, Lower Freeport? (Upper Kittanning) (water)	5	1003
Unrecorded	114	1117
Salt sand, broken (water, 1223′) and unrecorded	412	1529
Big Lime	75	1604
Big Injun sand (first pay, 1627″; break at 1646′; second pay, 1711′; third pay, 1717′)	75	1679
Unrecorded to bottom	69	1748

10″ casing, 380′; 8″ casing, 1443′; 5″ casing, 1605′.

E. H. Clevenger No. 1 Well Record (275).

Cass district, 1.2 miles N., 80° W. of Maidsville. Authority, Randall Gas & Water Company. Completed July 16, 1911.

(Elevation, 1170′ B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	107	107
Coal, Mapletown	5	112
Unrecorded	198	310
Coal, Pittsburgh	10	320
Unrecorded (water, 543′)	522	842
Sand, Big Dunkard and Burning Springs	203	1045
Coal, (Upper Kittanning)	5	1050
Unrecorded	117	1167
Salt sand	208	1375
Unrecorded	210	1585
Big Lime	51½	1636½
Big Injun sand (gas, 1643′-1649′; slate, 1661′-1670′; gas, 1756½′-1763′; gas, 1767½′-1777′) to bottom	141½	1777

10″ casing, 393′3″; 8¼″ casing, 1167′; 6 5/8″ casing, 1397′.

"Pressure in 6 5/8″ casing:

1st minute, 45 lbs.; Rock pressure, 245 lbs."

James Saunders No. 1 Well Record (277).

Cass district, at Maidsville. Authority, West Virginia Traction & Electric Company.

	Thickness. Feet.	Total. Feet.
Slate, lime, sand, red rock in layers, no coal	488	488
Coal, (Upper Freeport)	6	494
Slate and shale	20	514
Sand, ("Gas")	87	601
Coal, (Upper Kittanning)	6	607
Slate, lime, sand, red rock in alternate layers, no coal	548	1155
Big Lime	60	1215
Big Injun sand (first pay, 1348') and unrecorded to bottom	148	1363

10" casing, 148'; 8" casing, 613'; 6¼" casing, 946'; 5" casing, 1217'.

The Pittsburgh coal—Big Injun sand interval in this region is about 1325 feet; hence, the above record starts about 110 feet below the Pittsburgh coal.

Jasper Stone No. 1 Well Record (279).

Cass district, 1 mile northwest of Maidsville. Authority, Randall Gas & Water Company.

(Elevation, 895' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded (water, 40')	219	219
Little Dunkard sand and unrecorded	302	521
Big Dunkard sand and unrecorded	184	705
Coal, Freeport? (Upper Kittanning) and unrecorded (water, 1061')	545	1250
Big Lime	75	1325
Big Injun sand (gas at 1335', 1420', 1436' and 1450') to bottom	162½	1487½

10" casing, 242'; 8¼" casing, 668'; 6 5/8" casing, 1079'.
"Pressure test in 2" tubing:
1st minute, 95 lbs. Rock pressure, 250 lbs."

The above well starts nearly flush with the crop of the Pittsburgh coal; hence, the seam at 705' represents the Upper Kittanning.

M. G. Murphy No. 2 Well Record (280).

Cass district, 1.2 miles northwest of Maidsville. Authority, Mississippi Glass Company. Completed in May, 1911.

(Elevation, 910' B.-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded	12	12
Pittsburgh coal	10	22

	Thickness. Feet.	Total. Feet.
Unrecorded	425	447
Little Dunkard sand	15	462
Unrecorded	68	530
Sand, (Big Dunkard, Burning Springs and "Gas")	197	727
Coal, Freeport? (Upper Kittanning.)	4	731
Unrecorded	95	826
Sand	20	846
Coal, (Clarion)	6	852
Unrecorded	13	865
Lime (II Cow Run and Salt)	212	1077
Unrecorded	162	1239
Little Lime	15	1254
Unrecorded	81	1335
Big Injun sand (little gas, 1339'-1341'; slate, 1350'-1354'; little gas, 1365'-1370'; fair pay of gas, 1459'-1479')	155	1490
Unrecorded to bottom	0½	1490½

Peter Lazzell No. 1 Well Record (281).

Cass district, 1.3 miles northwest of Maidsville. Authority, Mississippi Glass Company. Completed in March, 1911.

(Elevation, 1170' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	134	134
Mapletown (Sewickley) coal	7	141
Unrecorded	66	207
Redstone coal	4	211
Unrecorded	18	229
Pittsburgh coal	13	242
Unrecorded	653	895
Coal, (Lower Freeport)	7	902
Gas sand	31	933
Coal, (Upper Kittanning)	6	939
Unrecorded	96	1035
Sand	30	1065
Unrecorded	4	1069
Coal, (Clarion)	10	1079
Sand, (II Cow Run and Salt)	225	1304
Unrecorded	186	1490
Big Lime	76	1566
Big Injun sand (gas pay, 1591'-1595'; slate, 1646'-1666'; second pay, 1666'-1681') and unrecorded to bottom	130	1696

T. A. and J. F. Keenan No. 1 Well Record (283).

Cass district, 1.2 miles N., 5° W. of Maidsville. Authority, West Virginia Traction & Electric Company. Completed Nov. 7, 1911.

(Elevation, 1035' B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Slate	4	18
Mapletown (Sewickley) coal	5	23

	Thickness. Feet.	Total. Feet.
Lime	34	57
Slate	29	86
Redstone coal	4	90
Lime	27	117
Pittsburgh coal	7	124
Slate, lime and sand in layers, no coal	562	686
Sand, Big Dunkard, and Burning Springs and "Gas"	151	837
Freeport coal (Upper Kittanning)	3	840
Slate and shells	116	956
Coal, (Clarion)	4	960
Sand, (Il Cow Run and salt)	178	1138
Sandy lime	69	1207
Red rock	15	1222
Gritty lime	46	1268
Red rock	86	1354
Little Lime	15	1369
Pencil cave	5	1374
Big Lime	78	1452
Big Injun sand (break, 1531'-1537'; first pay, 1542'-1545') and unrecorded to bottom	140	1592

10" casing, 197'; 8" casing, 845'; 6 5/8" casing, 1151'; 5 3/16" casing, 1495'; 2" tubing; packer set at 1517'.

Marion J. Garlow No. 1 Well Record (287).

Cass district, 1.8 miles north of Maidsville. Authority, Carnegie Natural Gas Company. Completed Dec. 4, 1906.

	Thickness. Feet.	Total. Feet.
Unrecorded	88	88
Pittsburgh coal	6	94
Unrecorded	1360	1454
Big Injun sand (gas, 1548' and 1562') and unrecorded to bottom	150	1604

10" casing, 230'; 8¼" casing, 1134'; 6 5/8" casing, none; 5 3/16" casing, 1538'.

" First pressure test in 5 3/16" casing:

1st minute, 55 lbs.	4th minute, 155 lbs.
2nd minute, 100 lbs.	5th minute, 170 lbs.
3rd minute, 130 lbs.	Rock pressure, 350 lbs.

An examination of the foregoing well records from the gas fields of Cass shows that the rock pressure in the Big Injun has fallen off greatly from that in the first wells drilled in the district, in which it was recorded at 550 pounds. This holds true in every gas field soon after the pool has been tapped by several wells. An interesting account of Rock Pressure in Oil and Gas Wells along with a discussion of the

causes and the maximum reported in the State is given on pages 65-73 of Vol. I (A) of the State Survey reports.

Prospective Oil and Gas Areas, Cass District.—Portions of Cass have been quite thoroughly tested by the drill for Big Injun gas and oil, but there yet remains quite a large area of the district favored by structure and untested in the deeper sands, and in addition a few small areas that would justify further drilling to the Big Injun. Discussing these areas roughly from west to east, (1) that portion of the district lying between the 725 and 775-foot contours of the Pittsburgh coal as outlined on Map II, northward from the Grant-Cass district line to near the head of Augustin run, appears favorable for Big Injun gas; (2) that, northward from the same district line between the 750 and 825-foot contours of the Pittsburgh coal to an east and west line through the Justice Brewer No. 1 well (263), for oil in the Bayard sand and light gas in the Big Injun; (3) that, northward from the same district line between the 825 and 925-foot contours of the Pittsburgh coal would warrant further tests for Big Injun gas; and (4) the same is true of that portion of the district southward from the State line to VanVoorhis between the Monongahela river and the 1150-foot contour of the Pittsburgh coal.

Grant District.

Grant district, Monongalia county, lies immediately south and east of Cass and Clay districts, west of the Monongahela river, and northeast of Marion County. With the exception of slightly over a square mile northeast of Uffington, its entire area lies along the western flank of the Indiana anticline; hence, practically the same structural conditions prevail as in Cass district. Within its borders the Pittsburgh coal horizon ranges in elevation from 625'A.T. on the extreme head of Little Indian Creek, to almost 1500'A.T. opposite Little Falls. No paying oil pools have yet been opened in the district, but a very prolific gas pool has been developed along its western edge on the head of Little Indian creek, consisting of 15 to 20 wells in which the Big Injun and Fifth sands are the main

producing horizons. The following records from wells in this field give interesting data as to the volume and pressure of the gas, the relative position of the sands and the thickness of the minable coals of the Monongahela series. The intervals from the Pittsburgh coal to the deep sands vary but little from that given for the western portion of Monongalia county, and the same is true for the Big Injun, the latter ranging from 1300 to 1325 feet.

Martha A. Miller No. 2 Well Record (298).

Grant district, 2.1 miles northeast of Hagans. Authority, West Virginia Traction & Electric Company. Completed in 1911.

(Elevation, 1255' B.-A. T.)	Thickness. Feet.	Total Feet.
Conductor	14	14
Unrecorded	226	240
Mt. Morris (Waynesburg) coal	..	240
Unrecorded	278	518
Mapletown (Sewickley) coal	..	518
Unrecorded	82	600
Pittsburgh coal	..	600
Unrecorded	1242	1842
Big Lime	57	1899
Big Injun sand (light gas pay, 2008')	141	2040
Unrecorded	17	2057
Squaw sand	53	2110
Unrecorded	321	2431
Sand, (Berea)	35	2466
Unrecorded	241	2707
Stray sand (gas show in top)	15	2722
Unrecorded	78	2800
Gordon sand (shales) and unrecorded	96	2896
Fourth sand	22	2918
Unrecorded	27	2945
Fifth sand, (first pay, small, 2955'; second pay, large, 2960') and unrecorded to bottom	35	2980

"2" connections for Big Injun gas; and 4" connections for Fifth sand gas."

The initial gas production in the Fifth sand in the above well was 7 to 8 million cu. ft. daily, with 700 pounds rock pressure, and in September, 1911, it was furnishing practically all the gas required by consumers in Morgantown, the other wells owned by same company being shut in temporarily.

J. N. Michael No. 1 Well Record (299).

Grant district, 2 miles northeast of Hagans. Authority, Carnegie Natural Gas Company. Completed Feb. 27, 1911.

(Elevation, 1215' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	557	557
Pittsburgh coal	..	557
Unrecorded	794	1351
Salt sand, (water, 1520')	211	1562
Unrecorded	302	1864
Big Injun sand	136	2000
Unrecorded	897	2897
Fifth sand (gas, 2907'-2919') and unrecorded to bottom..	28	2925

10" casing 620'; 8¼" casing, 1270'; 6⅝" casing, 1618'; 3" tubing, 2925'.

Pressure test in 3" tubing:

1st ½ minute, 260 lbs.
1st minute, 360 lbs.
2nd minute, 470 lbs.
3rd minute, 565 lbs.
4th minute, 625 lbs.
5th minute, 650 lbs.
60th minute, 685 lbs.

L. B. Brand No. 1 Well Record (296).

Grant district, 2.1 miles N., 70° E. of Hagans. Authority, West Virginia Traction & Electric Company. Completed Oct. 18, 1906.

	Thickness. Feet.	Total. Feet.
Unrecorded	424	424
Coal, Pittsburgh	..	424
Unrecorded	439	963
Dunkard sand and unrecorded	242	1205
Salt sand	160	1370
Unrecorded	256	1626
Big Lime	58	1684
Unrecorded and Maxton sand	31	1715
Unrecorded	47	1762
Big Injun sand (pay, 1859')	80	1842
Unrecorded	343	2185
Berea Grit (gas show, 2248')	24	2209
Unrecorded	40	2249
Gantz sand	41	2290
Unrecorded	15	2305
Fifty-foot sand	110	2415
Unrecorded	130	2535
Sand, (Gordon Stray)	20	2555
Unrecorded	18	2573
Gordon sand	17	2590
Unrecorded	200	2790
Fifth sand and unrecorded to bottom	171	2961

2" tubing, 1798'.

"Shot with 30 quarts in Injun; shot with 30 quarts in Gantz. Did not improve well."

Jehu Davis No. 1 Well Record (297).

Grant district, 2.2 miles northeast of Hagans. Authority, Hope Natural Gas Company.

(Elevation, 1490' B.-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded	450	450
Coal, (Waynesburg)	6	456
Unrecorded	272	728
Coal, Mapletown (Sewickley)	7	735
Unrecorded	76	811
Coal, Pittsburgh	10	821
Unrecorded	19	840
Sand	30	870
Unrecorded	480	1350
Sand, (Big Dunkard) (gas, 9/10" mercury in 2" tubing 1356')	20	1370
Unrecorded	370	1740
Salt sand (hole full of water, 1775')	65	1805
Unrecorded	213	2018
Little Lime	10	2028
Pencil cave	24	2052
Big Lime	84	2136
Sand 91 Unrecorded 5 Sand 20	**Big Injun** 116	2252
Unrecorded	80	2332
Sand, (Squaw)	33	2365
Unrecorded	292	2657
Sand, (Berea)	33	2690
Unrecorded	10	2700
Sand, (Gantz)	57	2757
Unrecorded	75	2832
Thirty-foot sand	13	2845
Unrecorded	77	2922
Gordon Stray sand	10	2932
Unrecorded (no Gordon sand)	68	3100
Fourth sand	15	3115
Unrecorded	38	3153
Fifth sand (gas show, 3177'; pay, 3187'; 2/10" mercury in 5 3/16" casing)	41	3194
Unrecorded to bottom	33	3227

The mercury gage test given for the Big Dunkard sand is equivalent to a daily gas production of 500,000 cu. ft., and that for the Fifth sand, to 1,670,000 cu. ft. daily.

J. N. Michael No. 1998 Well Record (300).

Grant district, 1.8 miles northeast of Hagans. Authority, Hope Natural Gas Company. Completed Oct. 11, 1911.

(Elevation, 1305' B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	299	315
Coal, native (Waynesburg)	4	319
Unrecorded	355	674
Pittsburgh coal	8	682
Unrecorded	890	1572
Third Salt sand (water, 1685')	116	1688
Unrecorded	105	1793
Maxton sand	22	1815
Unrecorded	65	1880
Little Lime	12	1892
Pencil cave	9	1901
Big Lime	62	1963
Big Injun sand (gas, 2158', 2165'-2225')	141	2104
Unrecorded	900	3004
Fifth sand (gas, 3009')	61	3065
Unrecorded to bottom	112	3177

10" casing, 724'; 8¼" casing, 1541'; 6 5/8" casing, 1911'; 5 3/16" casing (steel line measurement), 2780'.

Shot Oct. 12, 1911, with 15 quarts; top of shot, 3009'.

J. N. Michael No. 1 Well Record (301).

Grant district, 1.6 miles northeast of Hagans. Authority, Hope Natural Gas Company. Completed Feb. 2, 1911.

(Elevation, 1330' B.-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	228	244
Coal, native (Waynesburg "A") (steel line measurement)	6	250
Unrecorded	434	684
Pittsburgh coal (steel line measurement)	8	692
Unrecorded	1225	1917
Big Lime	73	1990
Big Injun sand (gas, 2067'-2079'; 12/10 water in 2" pipe; gas, 2087'-2095')	45	2135
Unrecorded	889	3024
Fifth sand (gas, 3040'; 4/10 mercury in 2" pipe) (steel line measurement)	51	3075
Unrecorded to bottom	136	3211

"10" casing, 737'; 8¼" casing, 1560'; 6 5/8" casing, 1927'; 5 3/16" casing, 2796'; 2" tubing, 3163'. Packer set at 2790'."

The gage test given above for the Fifth sand gas is equivalent to 350,000 cu. ft. daily, and that for the Big Injun, 165,000 cu. ft. daily.

J. N. Michael No. 2 Well Record (302).

Grant district, 1.9 miles northeast of Hagans. Authority, Carnegie Natural Gas Company. Completed July 9, 1911.

(Elevation, 1175' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	495	495
Pittsburgh coal	5	500
Unrecorded	1300	1800
Big Injun sand	134	1934
Unrecorded	916	2850
Fifth sand (gas, 2873')	31	2881
Unrecorded to bottom	6	2887

10" casing, 504'; 8¼" casing, 1145'; 6 5/8" casing, 1751'; 3" tubing, 2887'.

First pressure test in 3" tubing:

1st ½ minute, 125 lbs.	4th minute, 450 lbs.
1st minute, 200 lbs.	5th minute, 490 lbs.
2nd minute, 295 lbs.	10th minute, 530 lbs.
3rd minute, 380 lbs.	60th minute, 585 lbs.

J. N. Michael No. 3 Well Record (305).

Grant district, 1.7 miles N., 75° E. of Hagans. Authority, Carnegie Natural Gas Company. Completed Dec. 4, 1911.

(Elevation, 1265' B.-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	730	730
Pittsburgh coal	6	736
Big Injun sand (gas, 2025', 2135', and 2160') and unrecorded to bottom	1436	2172

First pressure test in 6 5/8" casing:

1st ½ minute, 25 lbs.	6th minute, 107 lbs.
1st minute, 35 lbs.	8th minute, 124 lbs.
2nd minute, 50 lbs.	10th minute, 135 lbs.
3rd minute, 70 lbs.	25th minute, 175 lbs.
4th minute, 85 lbs.	Rock pressure, 260 lbs.
5th minute, 90 lbs.	

The original rock pressure of Big Injun gas in this pool on the Clay district side of the line was over 500 pounds to the square inch.

Alpheus Morris (No. 3) Well Record (306).

Grant district, 1.6 miles northeast of Hagans. Authority, West Virginia Traction & Electric Company. Completed Dec. 23, 1911.

(Elevation, 1280' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	15	15
Slate, shells, lime and sand, no coal	493	508
Sewickley coal	7	515

	Thickness. Feet.	Total. Feet.
Slate, white	15	530
Lime	40	570
Slate, black	22	592
Pittsburgh coal	8	600
Slate, lime, sand, red rock and sand in layers, no coal	500	1100
Big Dunkard (gas, 1115′ and 1145′)	45	1145
Slate, shells and sandstone in layers, no coal	350	1495
Lower Salt sand (water, 1573′)	105	1600
Black sand	25	1625
Slate and shells	25	1650
Red rock	20	1670
Slate, black	30	1700
Maxton sand	40	1740
Slate, black	15	1755
Slate and shells	35	1790
Little Lime	17	1807
Pencil cave	16	1823
Big Lime (break, 1835′-1839′)	82	1905
Big Injun sand (gas, 1983′, 2000′)	140	2045
Slate and shells	55	2100
Sand, (Squaw)	60	2160
Slate and shells	165	2325
Berea Grit	30	2355
Slate and shells	80	2435
Gantz sand (gas, 2445′)	45	2480
Slate and shells	23	2503
Fifty-foot sand	67	2570
Slate and shells	15	2585
Sand, red (Thirty-foot)	35	2620
Slate and shells, red	81	2701
Gordon Stray sand	16	2717
Slate and shells, red	108	2825
Slate and shells, black	45	2870
Fourth sand	34	2904
Slate and shells, white	39	2943
Fifth sand	28	2971
Slate to bottom	9	2980

10″ casing, 627′7″; 8¼″ casing, 1578′10″; 6 5/8″ casing, 1859′; 5 3/16″ casing, 2710′.

Eugene Snyder No. 1 Well Record (295).

Grant district, 2.3 miles northeast of Hagans. Authority, Hope Natural Gas Company. Completed Nov. 11, 1905.

	Thickness. Feet.	Total. Feet.
Unrecorded	60	60
Coal, (Waynesburg)	5	65
Unrecorded	15	80
Coal, (Little Waynesburg)	5	85
Unrecorded	280	365
Coal, Mapletown (Sewickley)	7	372
Unrecorded	65	437
Coal, Pittsburgh	9	446

	Thickness. Feet.	Total. Feet.
Unrecorded	750	1196
Gas sand (gas, 1205')	94	1290
Unrecorded	15	1305
Salt sand (water, 1 bailer, 1310')	65	1370
Unrecorded	10	1380
Second Salt sand (water, 6 bailers, 1436')	66	1446
Unrecorded	214	1660
Big Lime	90	1750
Big Injun sand (gas, 1875', steel line measurement.)	158	1908
Unrecorded	895	2803
Fifth sand (gas, 2823', steel line measurement)	29	2832
Unrecorded	11	2843
Sand, (Bayard)	19	2862
Unrecorded to bottom, (steel line measurement)	30	2892

13¼" casing, 24'; 10" casing, 461'; 8¼" casing, 1270'; 6 5/8" casing, 1670'; 5 3/16"casing, 2212'.

Shot Nov. 11, 1895, with 20 quarts; 3½"x10' shell with 60' anchor.

J. C. Brand No. 2 Well Record (294).

Grant district, 2 miles southwest of Cassville. Authority, West Virginia Traction & Electric Company. Completed Nov. 20, 1907.

	Thickness. Feet.	Total. Feet.
Sandy lime and slate, no coal	240	240
Bluff sand	60	320
Coal, Mt. Morris (Waynesburg)	7	327
Slate, sand and lime in layers, no coal	248	575
Mapletown (Sewickley) coal	6	581
Slate	35	616
Lime	12	628
Slate	7	635
Lime	14	649
Black slate	6	655
Lime	10	655
Coal, Pittsburgh	9	674
Slate, shale, red rock, sand and red rock in layers, no coal	1231	1905
Big Lime	70	1975
Big Injun sand (first pay, 2056'; second, 2062') and unrecorded to bottom	176	2151

10" casing, 717'; 8¼" casing, 1330'.. 6 5/8" casing, 1718'; 5 3/16" casing, 1992'.

The two following records are from wells in the northern edge of Grant district, in which light pays of gas were encountered in the Big Injun and Gantz sands. Both were drilled below the Bayard sand and preclude the extension into this district of a possible Bayard sand oil pool southward from the Jas. Kennedy No. 1 well (261) on Scott run:

L. S. Bircher No. 1 Well Record (291).

Grant district, 1.4 mile southeast of Cassville. Authority, West Virginia Traction & Electric Company. Completed in 1909.

(Elevation, 1335′ B-A. T.)	Thickness. Feet.	Total. Feet.
Slate, etc.	112	112
Sand	58	170
Mt. Morris (Waynesburg) coal	6	176
Slate, lime, shale and sand in layers, no coal	353	465
Mapletown, (Sewickley) coal	7	472
Slate	20	492
Lime	17	509
Slate and shale	28	537
Lime	18	555
Slate	8	563
Pittsburgh coal	9	572
Slate, lime, red rock and sand in layers, no coal	1226	1798
Lime	19	1817
Black slate	8	1825
Big Lime	75	1900
Big Injun sand (pay, 1972′)	100	2000
Slate and shale	36	2036
Sand	30	2066
Slate	19	2085
Sand	40	2125
Slate and shale	35	2160
Sand, (Squaw)	30	2190
Slate and shale	70	2260
Lime and sand	27	2287
Slate	42	2329
Slate and shale	38	2367
Lime and sand	25	2392
Slate and shale	22	2414
Sand, (Gantz) (gas pay, 2417′)	59	2473
Slate	17	2490
Sand, (Fifty-foot)	38	2528
Red rock	35	2563
Slate and shale	46	2609
Red rock	83	2692
Sand shales, (Gordon)	47	2739
Slate	33	2772
Lime and sand, (Fourth)	30	2802
Slate and shales	60	2862
Sand shales, (Fifth)	48	2910
Slate	22	2932
Sand (Bayard)	76	3008
Slate and shales to bottom	58	3066

10″ casing, 600′6″; 8″ casing, 1151′; 6½″ casing, 1603′; 5″ casing, 1900″.

Sanford Barrickman No. 1 Well Record (290).

Grant district, 1.8 miles southeast of Cassville. Authority, West Virginia Traction & Electric Company.

(Elevation, 1085 B-A. T.)	Thickness. Feet.	Total. Feet.
Slate and shales, and lime in layers	178	178
Coal, Sewickley	6	184
Slate shale	23	207
Lime	12	219
Sand	7	226
Slate	17	243
Lime	11	254
Slate	14	268
Sand	5	273
Pittsburgh coal	8	281
Slate, lime, red rock, sand in layers, no coal	705	986
Coal, (Upper Kittanning)	5	991
Slate and shale	45	1036
Lime	7	1043
Black slate	13	1056
Gas sand	40	1096
Black slate	17	1113
Sand, Salt? (II Cow Run)	92	1205
Slate	18	1223
Sand (Salt)	60	1283
Slate and shale	75	1358
Red rock, slate, shale and red rock	165	1523
Big Lime	60	1583
Broken sandy lime	42	1625
Big Injun sand (gas show, 1697')	113	1738
Slate and shale	30	1768
Squaw sand	28	1796
Slate and shale	125	1921
Lime sand	40	1961
Slate and shale	75	2036
Sandy lime	27	2063
Slate and shale	130	2193
Sandy lime	23	2216
Slate	14	2230
Fifty-foot sand	57	2287
Break	13	2300
Sand, (Thirty-foot)	40	2340
Red rock	35	2375
Lime sand, (Gordon Stray)	18	2393
Slate and shale	25	2418
Red lime	30	2448
Slate	12	2460
Lime	10	2470
Slate	12	2482
Sand (Fourth)	30	2512
Slate	16	2528
Red rock	4	2532
Sand, (Fourth)	28	2560
Slate	30	2590
Sand, (Fifth)	26	2616

	Thickness. Feet.	Total. Feet.
Slate	33	2649
Sand, (Bayard)	52	2701
Slate and shale	84	2785

10" casing, 475'; 8" casing, 873'; 6 5/8" casing, 1400'; 5 3/16" casing, 1641'.

Two miles southeastward a dry hole (317) was drilled on the **J. W. Holland** farm by Messrs. Courtney & McDermott on a branch of Dents run, the detailed log of which is published on pages 134-135 of Vol. I(A) of the State Survey reports. This well penetrated 175 feet below the Bayard sand, and starts 55 feet by hand-level below the Pittsburgh coal.

One mile west of Morgantown the **Peninsula Company No. 1 well (318)** was drilled to a depth of about 1200 feet a short distance west of the crest of the Indiana anticline, in which a light show of gas was encountered. The well starts 65 feet by hand-level below the Harlem coal, according to Reger; hence it must have stopped near the base of the Big Injun, since the latter coal in this region belongs about 320 feet below the Pittsburgh coal. The gas pay was too light to be utilized by the owners—the Mississippi Glass Company.

Three miles southwestward the Round Bottom Oil & Gas Company drilled practically a **dry hole (316)** during 1910 on the **Jesse Camp farm,** 0.6 miles northwest of Round Bottom station. The well starts about 50 feet below the Pittsburgh coal and reached a depth of slightly over 2000 feet, according to S. G. Yoke of Morgantown, an interested party.

The **Ben J. Miller No. 1 well (312),** located in the extreme western point of Grant district, near the head of Craig run, is a light gasser. It was not learned in what sand the gas pay was encountered.

Prospective Oil and Gas Areas, Grant District.—The developed gas fields of both Cass and Grant districts, Monongalia county, lying southeast up the structural slope from the Mt. Morris-Fairview oil belt, appear to occur in more or less congested pools along this slope without relation to any special interruption of this slope with the possible exception of the pool west of Bowlby, while other territory apparently as well located from the standpoint of development and structure

is barren. This leads to the conclusion that the producing sands therein are quite irregular and not always porous, thus making it quite difficult for the geologist to point out good or bad territory. Hence, with the exception of the region on the head of Little Indian creek, drilling operations in Grant have not led to very encouraging results. However, there are several large areas therein that are so favored by structure as to warrant the drilling of more test wells. Taking up the discussion of these areas roughly from west to east, (1), that portion of the district lying northwest of Georgetown and Arnettsville on the waters of Snider and Stewart runs from a structural standpoint would justify the drilling of two or three test wells for Big Injun gas and Fifth sand oil; (2) that, southward from Flaggy Meadow run to the Monongalia-Marion county line between the 700 and 800-foot contours of the Pittsburgh coal as outlined on Map II, appears favorable for gas in the Big Injun and Fifth; (3) that along the crest of the Indiana anticline from the Monongahelia river at Westover to the same stream at Uffington for gas in the Big Injun and Berea sands in view of the showings encountered at these horizons in wells Nos. 318 and 332 in Morgantown and one mile west thereof; and (4) that, at Little Falls from the river west to the 1375-foot contour of the Pittsburgh coal, for gas in the same sands.

Union District.

Union district, Monongalia county, lies immediately east of the Monongahela river, south of Pennsylvania, west of Preston county and northeast of Morgan district; hence, its area is traversed in a northeast-southwest direction by three structural folds; viz., the Indiana and Chestnut Ridge anticlines, and the Connellsville (Uniontown) syncline, so that its strata are very much warped and twisted. The elevation of the Pittsburgh coal horizon therein varies from about 1070'A. T. at the State line, 0.7 mile southwest of Cheat Haven, Pa., to over 2500'A.T. in the extreme northeast corner of the district. Eight wells have been drilled within the boundaries of Union—2 on the west side of Cheat river and 6

on the east side, and only one paying well (323)—a gasser at Van Voorhis—has been obtained; in fact, this is the only paying well ever drilled on the east side of the Monongahela river in Monongalia county.

Taking up the drilling operations in the district from west to east, the **VanVoorhis-Bailey No. 1 well (323),** located at VanVoorhis was drilled several years ago by what is now the West Virginia Traction and Electric Company. According to Hon. E. M. Grant, it was drilled to a depth of about 1150 feet. The Big Injun sand was 130 feet thick but quite shelly with three or four light gas pays 110 feet in the sand. A pressure test in 2-inch tubing gave 80 pounds to the square inch for the first minute, and 350 pounds for the rock pressure. The initial volume of the well was estimated at one-half million cubic feet daily. This was mentioned above as the only paying well on the east side of the Monongahela in the county.

One mile southeastward the Randall Gas & Water Company during 1912 drilled practically a dry hole just west of the crest of the Indiana arch, the log of which as furnished the Survey by W. H. South, Manager, is as follows with slight modifications in parentheses by the writer:

D. M. Hoard No. 1 Well Record (322A).

Union district, 0.8 mile southeast of VanVoorhis. Authority, Randall Gas and Water Company.

	Thickness. Feet.	Total Feet.
Conductor box (surface gravel)	18.5	18.5
Unrecorded (water at 40′)	101.5	120
Sand, Murphy	20	140
Unrecorded	150	290
Sand	10	300
Unrecorded	100	400
Coal, (Brush Creek)	3	403
Unrecorded	58	461
Sand, Big Dunkard	33	494
Coal, Upper Freeport	5	499
Unrecorded	67	566
Gas sand	79	645
Unrecorded	83	728
Coal, (Clarion)	4	732
Unrecorded	27	759
Sand, (II Cow Run and Salt) water at 796′	193	952
Unrecorded	168	1120

	Thickness. Feet.	Total. Feet.
Little Lime	34	1154
Unrecorded	17	1171
Big Lime	52	1223
Slate and shells	35	1258
Big Injun sand (gas, small at 1323')	98	1356
Unrecorded to bottom	105.5	1461.5

10" casing, 334'; 8¼" casing, 774'; and 6 5/8" casing, 1175'.

"Tubed well for Mr. Hoard; pulled all casing and abandoned well as the volume was not sufficient for commercial use."

This well starts 60 to 90 feet below the Pittsburgh coal horizon, hence the above coal correlations are correct, but the thicknesses of the seams are probably excessive as will appear from the logs of the coal test borings along West run, herein published. Mr. South estimates the volume of the gas pay encountered at 20,000 cu. ft. daily.

During 1910 James Kuntz, Jr. & Co. of Washington, Penna., drilled a dry hole on the east bank of Cheat river in Union district, 1.5 miles due south of Stewartstown, the following log of which with slight modifications in parentheses was furnished the Survey by Hon. E. M. Grant of Morgantown. The well starts 50 feet by hand-level below the Elk Lick coal, or about 290 feet below the Pittsburgh bed:

Ed White No. 1 Well Record (324).

Union district, 0.5 mile north of Jaco. Authority, James Kuntz, Jr., & Company.

(Elevation, 840' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	27	27
Lime and shale	78	105
Coal, (Bakerstown)	..	105
Lime and shale	18	123
Sandstone and lime	33	156
Shale	9	165
Sandstone, (Buffalo)	45	210
Lime and shale	33	243
Sandstone, with water, (Mahoning)	57	300
Coal, Upper Freeport	..	300
Unrecorded and sandstone	14	314
Shale, black and brown	79	393
Lime, (Johnstown Cement.)	10	403
Sand	71	474
Shale, brown	16	490
Lime	10	500
Shale	20	520

	Thickness. Feet.	Total. Feet.
Coal, (Lower Kittanning)	..	520
Lime and shale	30	550
Coal streak, (Clarion)	...	550
Shale, black and brown	60	610
Sand, "Salt" (hole full of water)	100	710
Slate	95	805
Blue sandy lime	85	890
Slate	10	900
Red rock	54	954
Lime	16	970
Red rock	28	998
Big Lime	87	1085
Red rock	15	1100
Big Injun sand (upper 185' shelly)	320	1420
Slate and shells	180	1600
Lime and slate	60	1660
Sand, (Gantz)	60	1720
Unrecorded	35	1755
Sand (Fifty-foot)	10	1765
Slate and red rock	40	1805
Sand and lime	82	1887
Lime and red rock	98	1985
Shale and red rock	82	2067
Lime and shells	10	2077
Sand, (Fourth)	23	2100
Slate and shells	20	2120
Sand, (Fifth)	30	2150
Slate and shells	25	2175
Unrecorded	10	2185
Sand, (Bayard) gas show	50	2235
Slate and shells	15	2250
Lime, shells, etc.	357	2607

10" casing, 287'; 8¼" casing, 785'.

"Casing pulled and hole plugged to protect sands.

"Dry hole; sands regular, and very light show of gas at 2175'-2235'.

The detailed log of the **Francis Costolo No. 1 well (326)**, located 3¼ miles northeastward at the mouth of Morgan run, is published in connection with the section for the latter place, page 105. A showing of oil in the Big Injun sand was reported in this well. This record as well as that of the White well above, reveals a marked increase in the intervals from the Pittsburgh coal down to the Big Injun and deeper sands over the same in that portion of the county west of the Monongahela river, due largely to the southeastward thickening of the Pottsville and Mauch Chunk measures.

In this same region the **F. Costolo No. 1 well (327)**, located at the mouth of Rubles run, was drilled in the year 1865 to a depth of about 600 feet. A showing of oil was reported in this well, but it was not learned at what depth. During the same year the **Samuel Holt Heirs No. 1 well (329)**, located on Rubles run, just across the State line in Pennsylvania, was drilled to a depth of about 500 feet, in which a showing of gas was encountered.

One-fourth mile southward a light showing of gas was struck in the **Thos. Manning No. 1 well (325)**. The horizon of the gas pay and the total depth of the well was not ascertained.

The **Chess Bros. No. 1 well (330)**, located one mile northeast of Laurel Iron Works P. O., is reported as drilled by the South Penn Oil Company about 18 years ago to a depth of 2200 feet. The well was considered a dry hole. A strong stream of fresh water with a slight scum of oil was flowing from the well mouth when visited by the writer in January, 1910.

The log of the **Ley No. 1 dry hole (330A)**, located on the east bank of Cheat river, 0.3 mile southeast of Mont Chateau, is published in connection with the Quarry Run Section, page 108.

Prospective Oil and Gas Areas, Union District.—The foregoing is a complete list of drilling operations for oil and gas in Union district from which it is quite evident that the operator has not met therein with encouraging results. This is due in large measure to the fact that the most of the area of the district lies on the steeply pitching western slope of the great Chestnut Ridge anticline, or in a region where the fracturing of the strata has been carried on to such an extent that all the original stores of oil and gas that may have once existed therein have probably escaped into the air through defective covers, rendering it useless to drill in this locality to any ordinary depth. However, in the western portion of the district the folding is not nearly so pronounced, so that there is some territory in that locality which would warrant the drilling of further test wells. (1) That area lying immediately along the crest of the Indiana anticline from the State line southward to

the latitude of VanVoorhis, appears favorable for Big Injun gas; and (2) since the sands below the Big Injun are non-water bearing in this portion of the State, that territory lying immediately along the axis of the Connellsville syncline northeastward from Easton to the State line is favorably located from a structure standpoint for oil in the deep sands. However, the absence of gas in paying quantities in wells both to the east and west of this belt in the sands below the Big Injun and the dry hole (324) on the Ed White farm in this Basin on the east bank of Cheat renders the territory extremely problematical; in other words certain areas may be very favorably located with reference to structure for oil or gas, yet the causes leading to the genesis of these valuable hydro-carbons may never have prevailed in that region. Hence, the province of the geologist is not so much to point out producing territory as it is to discourage useless drilling.

Morgan District.

Morgan district, Monongalia county, lies immediately southwest of Union district and east of the Monongahela river, and is traversed by the same structural folds as the latter area; hence, practically the same structural conditions prevail in Morgan as in Union. Only seven wells have been drilled within its boundaries for oil and gas, all of which have proved non-paying for commercial purposes. Taking up the discussion of the logs of these wells from northwest to southeast across the district, the following is the record of a well completed during 1912 by the Randall Gas & Water Company on the south bank of West run, 1 mile southward from VanVoorhis, the log of which was furnished the Survey by W. H. South, Manager. The well mouth is about 280 feet below the horizon of the Pittsburgh coal:

Wayne Wilson No. 1 Well Record (321A).

(Elevation, 925' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor box (surface gravel)	14	14
Red rock	5	19
Lime	15	34

	Thickness. Feet.	Total. Feet.
Slate	15	49
Lime (water, hole full at 95')	50	99
Slate, white	26	125
Lime	15	140
Red rock	6	146
Slate, dark	5	151
Lime	29	180
Red rock	5	185
Lime	25	210
Slate	30	240
Coal, some gas, (Brush Creek)	4	244
Lime	41	285
Slate, dark	5	290
Lime	10	300
Slate, white	5	305
Dunkard sand (Big Dunkard)	30	335
Freeport coal, (Upper Freeport)	5	340
Slate, black	10	350
Slate, white	20	370
Lime	25	395
Slate, white	13	408
Lime, hard	8	416
Coal (some gas), Upper Kittanning	4	420
Slate, dark	10	430
Gas sand	55	485
Slate, black	9	494
Coal, (Lower Kittanning)	3	497
Slate	17	514
Sand, black, (Clarion)	10	524
Coal, (Clarion)	3	527
Slate	10	537
Lime	8	545
Sand, bailer full of water (II Cow Run)	20	565
Slate	30	595
Salt sand (hole full of water)	181	776
Slate, white	10	786
Lime	30	816
Sand	15	831
Slate	10	841
Lime	25	866
Sand, dark	25	891
Slate, white	8	899
Sand	5	904
Slate, white	6	910
Red rock	20	930
Lime	12	942
Slate, white	6	948
Red rock	6	954
Lime	6	960
Red rock	12	972
Slate	7	979
Lime	8	987
Slate	6	993
Red rock	10	1003
Slate	10	1013

	Thickness. Feet.	Total. Feet.
Big Lime	81	1094
Sand, (Keener)	12	1106
Red rock	6	1112
Big Injun sand, hard and white (1st gas at 1169'; second gas at 1205')	93	1205
Slate	7	1212
Big Injun sand (volume of gas very small)	136	1248
Lime	52	1300
Sand, (Squaw)	20	1320
Slate	100	1420
Lime	75	1495
Slate	20	1515
Lime	55	1570
Slate shells	30	1600
Lime	64	1664
Slate	12	1676
Slate	18	1694
Sand, (Gantz)	30	1724
Slate	6	1730
Lime	21	1751
Sand, (Fifty-foot)	14	1765
Slate	79	1844
Slate and shells	28	1872
Lime	10	1882
Red rock	5	1887
Slate	8	1895
Red rock	12	1907
Slate and shells	30	1937
Red rock	6	1943
Lime	10	1953
Red rock and lime	168	2121
Sand, (Fifth)	47	2168
Slate	19	2187
Sand ....55'		
Slate .... 5 (Bayard)	68	2255
Sand 8		
Slate to bottom, Aug. 15, 1912	25.5	2280.5

10" casing, 319'6"; 8¼" casing, 788'6"; 6⅝" casing, 1053'8".

"Volume of gas not sufficient for commercial purposes. All casing pulled, and hole plugged with wooden plug."

Mr. South estimates the volume of gas struck in the Big Injun at 20,000 cu. ft. daily.

Two miles southwestward along the strike of the strata, Hon. D. H. Courtney just recently completed a well on the north bank of the Monongahela, opposite Mona (Granville), the log of which as furnished the Survey with some slight changes and additions in parentheses is as follows:

Joseph and David Krepps No. 1 Well Record (320A).

Morgan district, 1.5 miles northwest of Morgantown. Authority, Globe Fuel Co.

(Elevation, 808′ L-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	40	40
Lime	20	60
Sand and lime (water, 62′)	55	115
White slate	35	150
Coal, (Brush Creek)	5	155
White slate	49	204
Red rock (?)	10	214
Coal, (Upper Freeport)	5	219
Slate and shells (water, 285′)	66	285
White slate	55	340
Black sand	45	385
Slate and shells	82	467
White sand, (Salt)	40	507
Slate	9	516
Coal, (Quakertown)	5	521
Salt sand	161	682
Black slate	30	712
Slate and lime shells	113	825
Red rock	25	850
White slate	25	875
Little Lime	20	895
Red rock	22	917
Big Lime	90	1007
Red rock	5	1012
Big Injun sand (small gas, 1075′)	120	1132
Lime	90	1222
White sand, (Squaw)	130	1352
Slate, lime and sand shells	133	1485
Slate and shells	45	1530
Dark lime	40	1570
Fifty-foot sand	70	1640
Red rock and shells	180	1820
Sand (Fourth) (little gas 1822′)	8	1828
Red rock and shells	122	1950
White slate	55	2005
Shells and sand	20	2125
White sand (Bayard)	15	2140
White slate to bottom	111	2251

10″ casing, 260′; 8¼″ casing, 553′; 6⅝″ casing, 880′.

The above well starts, according to Reger, 64 feet by hand-level below the Ames limestone and 149 feet below the Elk Lick coal, or approximately 400 feet below the Pittsburgh coal horizon.

The following is the log of a well completed during 1884 on the north bank of Decker's creek in Morgantown, 0.4 mile east of the crest of the Indiana anticline:

Snyder No. 1 Well Record (332).

Morgan district, at Morgantown. Completed in 1884.

(Elevation, 808' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	7	7
Hard gray sandstone, (Big Dunkard)	75	82
Shales, sandy	15	97
Coal, Brush Creek?	3	100
Shale and sandstone	40	140
Coal, Upper Freeport	4	144
Shales and very hard sandstone	76	220
Coal, (Upper Kittanning)	4	224
Shales and sandstone	100	324
Coarse, gray sandstone	20	344
Blue shales	20	364
Hard white sandstone (II Cow Run and Salt) (much water and some gas down to 540 feet, the last big water strike)	200	564
Sandstone, hard, micaceous, white	36	600
Sandy beds, greenish gray	100	700
Shales, red, and green sandy beds	120	820
Limestone	10	830
Shales, red	20	850
Limestone, (Big Lime)	60	910
Red sand and shales ..... 10'		
Hard fine sand and limy beds 88		
Blue sandy shales .....100 (Big Injun)	310	1220
Hard fine sand with some gas112		
Blue shales	150	1370
Dark, pebbly sand (gas, 1375) (Berea)	5	1375
Shells and hard fine sand (more gas)	108'6"	1483'6"
Gray sandy beds	171'6"	1655
Red shale and greenish gray shale	130	1785
Mostly red shale, and thin greenish gray shale	170	1955
Gray and red rock, and gray slate to bottom	312'6"	2267'6"

The above well is reported to have made 10,000 to 12,000 cu. ft. of gas daily from the pay at 1375 feet, but it was never utilized.

The **Ed Wells lot well (332A)**, located near the City Hospital in Morgantown, was drilled for water to a depth of 800 feet. It starts about 225 feet below the Pittsburgh coal horizon, so that it lacked about 375 feet of reaching the top of the Big Injun sand. No oil or gas in paying quantity was encountered.

During 1910 Jas. Kuntz, Jr. & Company of Washington, Pa., drilled a dry hole to a depth of approximately 3,000 feet below the Pittsburgh coal on Aaron creek in the southwest edge of Morgan district along the very steep western flank of

the Chestnut Ridge anticline. The following record of this well, kindly furnished by Hon. E. M. Grant of Morgantown, shows the sands very much broken and shelly and much red rock. The boring starts a few feet below the Upper Freeport coal, or approximately 600 feet below the horizon of the Pittsburgh bed:

Edmund Shisler No. 1 Well Record (340).

Morgan district, 3.1 miles east of Uffington. Authority, James Kuntz, Jr., & Company. Completed June 4, 1910.

	Thickness Feet.	Total. Feet.
Ground (soil)	6	6
Gravel	3	9
Slate and shells	7	16
Shell	4	20
Lime and sand	60	80
Slate	50	130
Lime	22	152
Slate	18	170
Sand	40	210
Coal, (Clarion)	3	213
Slate	14	227
Sand, (II Cow Run)	20	247
Slate	25	272
Shells	13	285
Lime and sand	25	310
Slate and shells	15	325
Sand and shells	10	335
Slate and shells	15	350
Slate	25	375
Red rock	70	445
Shells	20	465
Sand	15	480
Slate and lime	40	520
Salt sand	40	560
Red rock and lime	75	635
Lime and sand	15	650
Slate and lime	40	690
Red rock and lime	90	780
Lime and sand 15′ Red rock 30 Lime and sand 65 } (Greenbrier Limestone)	110	890
Slate and shells 130′ Sand 125 } (Big Injun)	255	1145
Lime and slate	155	1300
Sand	25	1325
Slate and shells	75	1400
Lime and sand	30	1430
Sand	40	1470
Slate	65	1535
Sand and slate	50	1585

	Thickness. Feet.	Total. Feet.
Lime and sand	40	1625
Slate and red rock	165	1790
Shells and red rock	120	1910
Sand and slate	55	1965
Red rock and slate to bottom	435	2400

"Result, Dry hole; sands broken and inferior from Injun down. 10" casing, 194'; 8¼" casing, 482'; 6⅝" casing, 1167'. All casing pulled; hole plugged to protect sands."

If the above log is correct the Mauch Chunk series is almost 400 feet thick, the greatest recorded in the three counties. A slight scum of oil and a strong stream of fresh water was encountered in the Big Injun, which flows out the top of the hole.

The **Hagedorn & Sons No. 1 well (338)**, located on Deckers creek at the southeast edge of Dellslow, was completed in 1863 according to Chas. Hagedorn of the latter place, who reports a strong flow of gas struck at a depth of 600 feet. Mr. T. M. Pixler of the same town says his father reported the well 700 to 800 feet deep, at which depth a strong flow of gas and salt water was encountered, blowing down the drilling apparatus. The well starts 950 to 1000 feet below the horizon of the Pittsburgh coal; hence, the gas pay was probably in the Big Injun sand, since this horizon is generally water bearing, while the sands below are not. A light flow of gas still comes from the well mouth. The gas was never utilized.

The **Maiden Spring Run well (339)**, located 1.5 miles southeast of Dellslow, at the mouth of Maiden Spring run of Deckers creek, was completed in 1863, according to Mr. Hagedorn above mentioned, who reports the well as having reached a depth of 700 to 800 feet, and in addition to a strong flow of salt water a slight flow of oil was encountered. As the well starts in the Big Lime (Greenbrier Limestone), it evidently stopped near the top of the Gordon sand.

Prospective Oil and Gas Areas, Morgan District.—As mentioned at the beginning of the discussion of Morgan district practically the same structural conditions prevail as in Union to the northeast, which taken in connection with the barren test wells therein do not hold out much hope that the oil and gas operator will ever open a very prolific pool of

either in the district. However, that territory immediately northeastward from the river at Morgantown along the axis of the Indiana anticline to the 1250-foot contour of the Pittsburgh coal as outlined on Map II, appears favorable for light gas wells in the Big Injun and Berea sands; and, in view of the Berea gas in the Snider well (332) at Morgantown and the fact that the latter sand is non-water bearing, that area lying immediately along the axis of the Connellsville syncline from Easton southwest to Deckers creek may hold a small pool of oil at this horizon. The Berea gas pay was so light in the Snider well that the writer does not specially recommend the territory. All the eastern portion of the district lies in the region of very steep dips with the sands broken and shelly as revealed by the Shisler well (340) the log of which is given on a preceding page, so that no paying wells need be expected in this portion of Morgan. A well 1000 to 1200 feet deep where the axis of the Chestnut Ridge anticline crosses Decker's creek would test all the sands below the Big Injun down to and including the Bayard, and such a boring might result in a paying gas well owing to the dome-like structure there, but the risk would be great, since fracturing is always prevalent with folds of the magnitude of this great arch.

Clinton District.

Clinton district lies immediately southwest of Morgan district and east of the Monongahela river, and its area is traversed by the same structural folds with the same structural conditions prevailing as in Union and Morgan. The results of drilling operations for oil and gas therein have been equally unsatisfactory, since out of five wells drilled none has proved productive of either oil or gas in paying quantity.

The log of the **F. M. Johnson No. 1 well (341)**, located 0.5 mile southeast of Uffington and completed during 1900, is published in detail on pages 133-134 of Vol. I(A) of the State Survey reports. Only slight shows of oil or gas were found in any of the sands. The boring penetrated to a depth of 360 feet below the Bayard sand.

The following is the log of a very light Bayard sand gasser

in the extreme southwest edge of Clinton. The well starts 30 to 40 feet below the Brush Creek coal, or approximately 560 feet below the Pittsburgh coal horizon:

Rose Watson No. 1907 Well Record (344).

Cinton district, 0.4 mile south of Smithtown. Authority, Philadelphia Company. Completed May 3, 1901.

(Elevation, 970′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	227	227
Coal, (Lower Kittanning)	5	232
Unrecorded	415	647
Salt sand	40	687
Unrecorded	218	905
Big Injun sand	152	1057
Unrecorded	393	1450
Fifty-foot sand	90	1540
Unrecorded	506	2046
Sand, (Bayard) (very small gas, 2046′)	3	2049

10″ casing, 101′; 8″ casing, 520′; 6″ casing, 1020′. Abandoned July 17, 1901.

During 1911 the **Wm. E. Watson No. 1 well (343),** located 1.3 miles northwest of Whiteday (Smithtown) on the head of Bunner's run, was drilled to a depth of 2450 feet below the Pittsburgh coal, cropping in the hill above the well, without getting either oil or gas.

One mile northwest of Triune the Hope Natural Gas Company recently completed a dry hole **(342A) on the Minor Tennant farm,** the log of which was not obtained.

The **Furnace Tract No. 1 well (342),** located 0.4 mile southeast of Clinton Furnace and completed in 1865, was drilled to a depth of only 300 feet, according to Mr. O. C. Johnson of the latter place. The well starts about 775 feet below the horizon of the Pittsburgh coal; hence, it lacked 300 to 350 feet of getting down to the top of the Big Injun sand. No oil or gas was encountered, but 5 to 7 feet of coal was reported at a depth of about 75 feet, representing the Upper Mercer bed.

Prospective Oil and Gas Areas, Clinton District.—In that portion of Clinton district, Monongalia, lying to the southeast of the 1600-foot contour of the Pittsburgh coal as outlined on Map II, the dip of the strata is so rapid and the folding so

intense that it is quite problematical whether any paying oil or gas pools will ever be opened. The axis of the great Chestnut Ridge arch falls quite rapidly southwestward from its intersection with the Morgan-Clinton district line to and beyond the Monongalia-Marion county line, and the territory along the crest of this anticline eastward from Halleck may possibly hold a gas pool, but, as mentioned heretofore, the probability of cracks and faulting—always associated with intense folding—may have long ago permitted the gas to escape into the air. However, in the western portion of Clinton, a structural terrace has been formed by the intersection of the Indiana anticline with the steep western slope of the Chestnut Ridge arch, as shown on Map II, by the wide divergence of the 1450 and 1600-foot contours of the Pittsburgh coal; hence, structural conditions are favorable for a paying oil and gas pool in the Big Injun and deeper sands in that portion of the district lying immediately west of Booth's creek, northwest of the 1575-foot contour of the Pittsburgh coal, north of an east and west line through Smithtown and east of the 1450-foot contour of the Pittsburgh coal, the whole covering an area of 8 to 10 square miles. A boring in the vicinity of Little Falls would test fairly well the included area.

MARION COUNTY WELL RECORDS.

The accompanying table contains the abbreviated logs of 358 borings from Marion county as well as levels on most of the same, along with elevations and data on 88 other wells the records of which were not obtainable. As with the Monongalia county list, these wells have been selected on account of their wide distribution and in some instances for some special feature associated with the well. The borings are numbered from 345 to 689 and grouped as in the table for Monongalia, first by magisterial districts and then by oil and gas pools, the serial number in each instance corresponding to the number of the same well on Map II. For further particulars the reader is referred to the explanations directly following the Monongalia table, page 414. Under the column headed "Owner," the following abbreviations are used:

Anchor	Anchor Oil Company.
Brown & Co.	Leonard Brown & Co.
Burt	Burt Oil Company.
Carnegie	Carnegie Natural Gas Company.
Chartiers	Chartiers Oil Company.
Clark	Clark Oil Company.
Clayton	Clayton Oil Company.
Cons. Coal	Consolidation Coal Company.
Consolidation	Consolidation Oil Company.
Delmar	Delmar Oil Company.
Excelsior	Excelsior Oil & Gas Company.
Fairmont	Fairmont Gas Company.
Fayette	Fayette County Gas Company.
Fisher	Fisher Oil Company.
Freehold	Freehold Oil & Gas Company.
Georges Creek	Georges Creek Coal & Iron Company.
Grant Dev	Grant Development Company.
Hartman	Hartman Oil Company.
Hog Lick	Hog Lick Oil & Gas Company.
Hope	Hope Natural Gas Company.
Hukill	E. M. Hukill & Company.
Marsh	Marsh Oil & Gas Comapny.
Miller & Co.	Geo. E. Miller & Company.
Monongahela	Monongahela Gas Company.
McCune	McCune Oil Company.
National	National Oil & Gas Company.
New Central	New Central Coal Company.
Pgh.-Buffalo	Pittsburgh-Buffalo Coal Company.
Phila.	Philadelphia Company.
South Penn	South Penn Oil Company.
U. S. Oil	United State Oil Company.
Venture	Venture Oil Company.
West Va.	The West Virginia Company.
W. Va. T. & E.	West Virginia Traction & Electric Company.
Wheeling	Wheeling Natural Gas Company.

In the elevation column the letter "B" indicates that the elevation of the well mouth was determined with aneroid barometer checked with nearby U. S. G. Survey spirit level elevations; the letter "L," with spirit level, the same being expressed in feet above tide. Depths to the Pittsburgh coal and the several sands are also expressed in feet. For the abbreviations under column headed "Producing Sand and Remarks," the reader is referred to page immediately following the Monongalia table of wells.

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
345	N. M. Glover	Mannington	Hope	1305B
346	Jemima Metz	Mannington	Carnegie	1410B
347	Dorcas (T.J.) Ash No. 2	Mannington	South Penn	1100B
348	L. A. Keenan No. 1	Mannington	South Penn	1135B
349	Rebecca Glover No. 1	Mannington	Cochran & Funk	1460B
350	R. M. Stewart No. 1	Mannington	Barras et al.	1165B
351	John Glover No. 1	Mannington	Fisher	1460B
352	C. W. Murphy No. 1	Mannington	Hope	1150B
353	A. M. Glover No. 2	Mannington	Venture	1154L
354	A. M. Glover No. 4	Mannington	Venture	1160B
355	A. M. Glover No. 3	Mannington	Venture	1070B
356	Solomon Glover No. 1	Mannington Church	Carnegie	1610B
357	W. F. Smith No. 2418	(Wetzel Co.)	Phila	1200B
358	J. L. Murray No. 1	Mannington	Hope	1155B
359	Geo. T. Hamilton No. 1	Mannington	Carnegie	1235B
360	J. L. Hamilton No. 1	Mannington	Hope	1085B
361	Geo. W. Hamilton No. 1	Mannington	Carnegie	....
362	Calvin Hamilton No. 1	Mannington	Carnegie	1235B
363	Jacob Myers No. 1	Mannington	South Penn	1371L
364	James Toothman No. 1	Mannington Grant	Hope	1355B
365	Furbee Heirs No. 3	(Wetzel Co.)	Carnegie	1440B
366	John Snodgrass No. 1	Mannington	F. Bartlett	1197B
367	John Ott No. 1	Mannington	South Penn	1160L
368	Wm. Devore No. 2	Mannington Grant	South Penn	1395B
369	E. Batson No. 2	(Wetzel Co.)	South Penn	1290B
370	J. T. Satterfield No. 2	Mannington	Snyder & Pence	1195B
371	Riley Arnett No. 2	Mannington	South Penn	1120B
372	Riley Arnett No. 1	Mannington	South Penn	1055B
373	Joseph Hayhurst No. 4	Mannington	South Penn	1065B
374	Joseph Hayhurst No. 1	Mannington	South Penn	1028L
375	Rachel Evans No. 1	Mannington	Hartman	1170B
376	Enoch Evans No. 3	Mannington	Clayton	1040B
377	Geo. Watson No. 1	Mannington	South Penn	1110B
378	Jacob L. Murray No. 1	Mannington	South Penn	1040B
379	Nancy L. Murray No. 1	Mannington	Hope	1080B
380	M. M. Kendall No. 135	Mannington	Hope	1070B
381	Henry Straight No. 1	Mannington	Kirkland et al.	1125B
382	Wm. Straight No. 1	Mannington	Kirkland et al.	1170B
383	John W. Batson No. 1	Mannington	South Penn	1295B
384	John Baker No. 4	Mannington	South Penn	....
385	J. L. Hayes No. 1	Mannington	T. N. Barnsdale	1160B
386	Jas Hawkinberry No. 1	Mannington	South Penn	1125B
387	Henry Baker No. 1	Mannington	Fisher	1050B
388	B. Wells No. 1	Mannington	Burt	1045B
389	Benj. Dodd No. 3	Mannington	South Penn	1255B

Wells in Marion County.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
1018	.....	2303	.....	.....	.....	.....	2460	B. I. gas.....	345
.....	.....	.....	.....	.....	.....	.....	.....	———	346
918	7	2196	2933	3064	.....	.....	3077	Max., B. I., 50-ft. gas; Gord. oil.....	347
969	7	2240	2978	3108	3152	3209	3240	Max. gas, 30-ft. oil.....	348
1280	8	2585	3294	.....	.....	.....	3315	30-ft. oil.....	349
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil.....	350
1280	10	2585	3301	.....	.....	.....	3320	30-ft. oil.....	351
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas.....	352
960	6	2246	2986	.....	.....	.....	3001	30-ft. oil.....	353
952	6	2250	2985	.....	.....	.....	3001	B. I. gas, 30-ft. oil.....	354
857	6	2163	2884	.....	.....	.....	2903	30-ft. oil.....	355
1380	6	2676	.....	3562	3628	.....	3723	Dry hole.....	356
982	.....	2253	.....	3082	3160	.....	3383	B. I. gas, Gord. & 4th oil.	357
935	.....	2229	.....	3083	.....	.....	3257	Gordon gas.....	358
1000	8	2270	.....	.....	.....	.....	2355	B. I. gas.....	359
965	.....	2260	.....	.....	.....	.....	3138	Gord. gas show.....	360
1160	.....	2440	.....	3322	.....	.....	3356	B. I. & 4th gas, Max. oil.	361
990	8	2272	.....	3074	3147	.....	3177	B. I., Gord. & 4th gas...	362
.....	.....	.....	.....	.....	.....	.....	.....	———	363
1060	.....	.....	.....	.....	.....	.....	2197	Max. gas.....	364
.....	.....	.....	.....	.....	.....	.....	.....	———	365
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil.....	366
907	8	2198	.....	.....	.....	.....	2325	B. I. oil.....	367
1180	7	2466	.....	.....	.....	.....	2538	B. I. oil.....	368
1045	8	2343	.....	.....	.....	.....	2445	B. I. gas and oil.....	369
.....	.....	.....	.....	.....	.....	.....	.....	———	370
952	5	2225	2941	.....	3126	.....	3220	Max. oil; Stray gas.....	371
872	13	2148	.....	.....	3085	.....	3297	B. I. gas; 4th oil.....	372
880	.....	.....	.....	.....	.....	.....	2071	Max. oil.....	373
844	11	2143	.....	2993	.....	.....	3088	Salt, 50-ft. gas; Max., Gord. oil	374
1005	.....	2305	.....	.....	.....	.....	3345½	Dry hole.....	375
.....	.....	.....	.....	.....	.....	.....	.....	Max. oil.....	376
863	7	2183	2880	3018	.....	.....	3088	Stray gas; Gord. oil show	377
833	5	2155	.....	.....	.....	.....	2328	Dry hole.....	378
870	.....	2180	.....	.....	.....	.....	2880	50-ft. gas.....	379
776	.....	2080	.....	2925	.....	.....	3008	Gord. oil.....	380
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil.....	381
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole.....	382
1078	11	2399	.....	.....	.....	.....	2523	B. I. gas and oil.....	383
1256	7	2566	.....	.....	.....	.....	2675	B. I. oil.....	384
.....	.....	.....	.....	.....	.....	.....	.....	———	385
860	12	2174	.....	3050	.....	.....	3162	B. I. oil; Gord. gas.....	386
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole.....	387
800	.....	2105	2835	.....	.....	.....	2859	30-ft. oil.....	388
1008	12	2318	.....	.....	.....	.....	2448	Gas sand gas & B. I. oil.	389

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
390	Benj. Dodd No. 2	Mannington	South Penn	1060B
391	Jacob Baker No. 1 (?)	Mannington	Burt	1095B
392	Sarah L. Kendall No. 1	Mannington	Hartless & Barris	1035B
393	August Sturm No. 2	Mannington	Freehold	1070B
394	Snodgrass Bros. No. 3	Mannington	Freehold	1055B
395	M. W. Sturm No. 2	Mannington	South Penn	....
396	Lusetta Snodgrass No. 1	Mannington	South Penn	....
397	Farrell Heirs No. 2	Mannington	Hartman	1190B
398	Aaron Furbee No. 1	Mannington	South Penn	1018L
399	Farrell Heirs No. 4	Mannington	Hartman	1185B
400	Barnes & Fleming No. 2 (?)	Mannington	South Penn	1320B
401	Farrell Heirs No. 3	Mannington	Hartman	1015B
402	Lemley & Hibbs No. 1	Mannington	Hartman	1125B
403	T. P. Freeland No. 1	Mannington	South Penn	1015B
404	Wm. Robey No. 1	Mannington	West Virginia	1005B
405	T. P. Freeland No. 1	Mannington	Monongahela	1010B
406	Wm. Metz (Z. Tennant) No. 1	Mannington	Taylor	1010L
407	John W. Brummage No. 1	Mannington	———	....
408	Scott Arnett No. 1	Mannington	South Penn	1247L
409	John Styles No. 1	Mannington	South Penn	1060B
410	E. Moore Heirs No. 1	Mannington	South Penn	....
411	I. E. Arnett No. 2	Mannington	South Penn	....
412	E. Moore Heirs No. 2	Mannington	South Penn	1060B
413	Joseph Campbell No. 1	Mannington	South Penn	1090B
414	Isaac Campbell No. 3	Mannington	South Penn	1100B
415	I. E. Arnett No. 1	Mannington	South Penn	1074L
416	Elizabeth Thomas No. 1	Mannington	South Penn	1086L
417	Samuel Moore No. 1	Mannington	South Penn	1115B
418	Simon Moore No. 1	Mannington	South Penn	1135B
419	Jas. Fox No. 1	Mannington	South Penn	1190B
420	Isaac Campbell No. 2	Mannington	South Penn	....
421	Isaac Campbell No. 5	Mannington	South Penn	....
422	Guy Arnett No. 1	Mannington	Wheeling	....
423	I. F. Thomas No. 1	Mannington	South Penn	1075B
424	Asbury Moore No. 1	Mannington	South Penn	1495B
425	John Grubb No. 2	Mannington	South Penn	1109L
426	Sanford Toothman No. 1	Mannington	South Penn	....
427	W. R. Dickens No. 1	Mannington	———	1065B
428	Mike Snyder No. 2	Mannington	South Penn	1174L
429	J. A. Thomas No. 1	Mannington	South Penn	1021L
430	Absalom Holbert No. 1	Mannington	Burt	1030B
431	Ash Fluharty No. 1	Mannington	South Penn	1000L
432	E. J. Freeland No. 1	Mannington	South Penn	....
433	C. W. Bayles No. 1	Mannington	South Penn	1000B
434	Francis Mason No. 1	Mannington	Story et al	975B
435	C. W. Bayles No. 2	Mannington	South Penn	1030B
436	Catherine Tennant (No. 3?)	Mannington	South Penn	1000B
437	Frank O. Price No. 1	Mannington	South Penn	1050B
438	Isaac Hibbs No. 2	Mannington	———	1085B
439	Isaac Hibbs No. 1	Mannington	———	1070B

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
800	10	2118	.....	.....	.....	.....	2240	B. I. oil, 100 bbls.....	390
802	8	2130	2838	.....	.....	.....	3240	Salt gas; 30-ft. oil.....	391
.....	.....	.....	.....	.....	.....	.....	.....	———	392
850	.....	2165	2884	.....	.....	.....	2909	30-ft. oil show; B. I. gas	393
812	.....	2105	2855	2978	.....	.....	3002	Gord. oil; B. I. gas light.	394
1080	5	2373	3117	3250	.....	.....	3347	———	395
895	10	2195	.....	3067	.....	.....	3090[est]	Gord. oil; 30-ft. show...	396
929	.....	2248	.....	3110	.....	.....	3133	B. I. oil?.....	397
767	7	2072	2820	2939	.....	.....	2967	Gord., B. I. & 30-ft. oil..	398
927	.....	2245	.....	.....	.....	.....	2346	B. I. oil.....	399
1079	.....	2390	.....	3260	.....	.....	3285	Gord. oil.....	400
755	.....	2080	.....	2936	.....	.....	2957	B. I. oil?.....	401
866	.....	2206	.....	.....	.....	.....	2284.9	B. I. oil.....	402
755	7	2070	.....	.....	.....	.....	2184	B. I. oil.....	403
.....	.....	.....	.....	.....	.....	.....	.....	———	404
.....	.....	.....	.....	.....	.....	.....	.....	———	405
.....	.....	.....	.....	.....	.....	.....	.....	———	406
.....	.....	.....	.....	.....	.....	.....	.....	———	407
1010	.....	2340	.....	3175	.....	.....	3202	Gord. oil.....	408
815	7	2140	2875	2978	.....	.....	3010	Gord. oil; B. I. gas.....	409
1175	10	2520	.....	3330	.....	.....	3340	Gord. oil, large.....	410
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole.....	411
848	7	2130	.....	2992	.....	.....	3016	Gord. oil.....	412
865	.....	2180	.....	3018	.....	.....	3040	Gord. oil.....	413
887	.....	2187	.....	3033	3135	.....	3150?	Gord. oil.....	414
.....	.....	.....	.....	3094	3134	3307	3308	Gord. oil	415
900	10	2175	.....	3055	3156	.....	3178	Gord. oil.....	416
.....	.....	.....	.....	.....	.....	.....	.....	Gord. oil.....	417
945	7	2279	.....	3112	3164	3195	3218	Gord. oil show.....	418
1000	8	2345	.....	3145	.....	.....	3198	Gord. oil.....	419
1006	.....	2300	.....	3156	3254	.....	3275	Gord. and 4th oil.....	420
990	.....	2290	2985	3154	3235	.....	3258	Gord. and 4th oil.....	421
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole.....	422
790	.....	2066	.....	2975	3050	.....	3196	B. I. gas show.....	423
.....	.....	.....	.....	.....	.....	.....	.....	Gordon?	424
800	.....	2070	.....	.....	2996	.....	3030	B. I. and 4th oil.....	425
1000	.....	2250	.....	3140	3203	.....	3268	4th oil, show B. I. & Gnz.	426
740	8	2012	.....	2920	.....	.....	3358	4th oil show; B. I.....	427
810	.....	2137	2825	2970	3032½	.....	3064	4th and B. I. oil.....	428
651	7	1985	.....	.....	.....	.....	2895	4th oil.....	429
.....	.....	.....	.....	.....	.....	.....	.....	———	430
607	.....	1933	.....	.....	.....	.....	2054	B. I. oil.....	431
1025	.....	2342	.....	3198	3228	.....	3299	B. I. & 5th oil; 50-ft. gas	432
617	10	1930	.....	2779	2815	.....	2899	4th oil; B. I. & 50-ft. gas	433
.....	.....	.....	.....	.....	.....	.....	.....	———	434
640	.....	.....	.....	.....	.....	.....	.....	4th gas.....	435
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil.....	436
661	.....	2000	.....	2865	2900	.....	2929	4th oil.....	437
.....	.....	.....	.....	.....	.....	.....	.....	———	438
.....	.....	.....	.....	.....	.....	.....	.....	———	439

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T
440	S. C. Hibbs No. 1	Mannington	Hayes et al.	1105B
441	Bert Haines	Mannington	Hayes & Koen	1160B
442	M. A. Prichard Heirs No. 1	Mannington	South Penn	1150B
443	Isaac Efaw No. 5	Mannington	Carnahan	1420B
444	C. S. Pitzer No. 2	Mannington	South Penn	1450B
445	Isaac Efaw No. 1	Mannington	Carnahan	1115B
446	C. S. Pitzer No. 1	Mannington	South Penn	1320B
447	J. L. Beaty No. 1	Mannington	South Penn	1130B
448	A. J. Hayes No. 8	Mannington	Delmar	1300B
449	Benj. Grubb No. 3	Mannington	Freehold	1080B
450	A. J. Hayes No. 15	Mannington	Delmar	1060B
451	B. B. Board No. 1	Mannington	Freehold	1010B
452	B. B. Board No. 2	Mannington	Freehold	1010B
453	A. J. Hayes No. 13	Mannington	Delmar	1025B
454	Joseph McGill No. 1	Mannington	Wheeling	995B
455	A. F. Hamilton	Mannington	Koen & Beaty	1014L
456	Fred Beaty No. 1	Mannington	Beaty et al.	1080B
457	George Beaty No. 3	Mannington	Anchor	995B
458	George Beaty No. 1	Mannington	Anchor	1000B
459	Jas. Hayes No. 1	Mannington	Hope	1175B
460	Jonathan Arnett No. 1	Mannington	Carnegie	1055B
461	Perry Arnett No. 1	Mannington	Carnegie	1100B
462	W. N. Cunningham No. 4	Mannington	South Penn	1075B
463	W. N. Cunningham No. 1	Mannington	South Penn	1071L
464	Jacob Cunningham No. 9	Mannington	South Penn	1070B
465	Jacob Cunningham No. 3	Mannington	South Penn	1155B
466	Jacob Brummage No. 1	Mannington	South Penn	1370B
467	Cephus Higgins No. 2	Grant (Wetzel Co.)	South Penn	1215B
468	S. J. Gump No. 1	Mannington	Hope	1030B
469	Alexander Huey No. 1	Mannington	Delmar	....
470	Newton Huey	Mannington	Huey et al.	1085B
471	M. W. Huey Heirs No. 1	Mannington	South Penn	1320B
472	J. A. Harbert No. 1	Mannington	South Penn	1085B
472A	George A. Huey No. 1	Mannington	South Penn	1350B
473	A. J. Ice, Sr., No. 1	Mannington	Delmar	1100B
474	Daniel F. Heldreth No. 1	Mannington	Chartiers	1145B
475	Jesse Talkington No. 1	Mannington	Delmar	1085B
476	Ellis Shriver	Mannington	Clark	....
477	Isabel Moore No. 1	Mannington	Clark	1075B
478	A. H. Heldreth No. 1	Mannington	Delmar	1050B
479	Serepta Cunningham No. 1	Mannington	South Penn	1055B
480	P. C. McDonald No. 3	Mannington	Delmar	1085B
481	W. T. Ice No. 8	Mannington	Delmar	1090B
482	Joshua Looman No. 1	Mannington	Delmar	....
483	B. F. Robinson No. 4	Mannington	Delmar	....

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	Gord. oil show.....	440
.....	.....	.....	.....	.....	.....	.....	.....	———	441
744	.....	1804	.....	2674	.....	.....	2704	B. I. oil show; 4th oil...	442
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil.....	443
1120	.....	2445	3162	.....	.....	.....	3187	50-ft. gas; 30-ft. oil.....	444
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil.....	445
982	8	2292	3023	.....	.....	.....	3052	30-ft. oil.....	446
774	10	2108	2805	2933	3042	.....	3111	30-ft. oil & Salt Gord. gas	447
1007	9	2343	3020	.....	.....	.....	3037	30-ft. oil.....	448
790	.....	2105	2800	.....	.....	.....	2823	30-ft. oil.....	449
768	.....	2098	2775	.....	.....	.....	2826	30-ft. oil.....	450
720	7	.....	2724	2850	.....	.....	.....	30-ft. oil; Gord. gas show	451
.....	.....	.....	2718	.....	.....	.....	2736	30-ft. oil.....	452
710	8	2040	2720	2838	.....	.....	2870	30-ft. oil; Gord. gas.....	453
.....	.....	.....	.....	.....	.....	.....	.....	———	454
.....	.....	.....	.....	.....	.....	.....	.....	———	455
.....	.....	.....	.....	.....	.....	.....	.....	———	456
645	.....	.....	.....	.....	.....	.....	.....	Gord. gas.....	457
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil.....	458
921	.....	2223	.....	3079	.....	.....	3130	B. I., Gordon gas.....	459
818	.....	2145	.....	2928	2966	.....	2998	Gord. and 4th gas.....	460
893	.....	2187	.....	3035	.....	.....	3049	———	461
915	8	2238	.....	2990	.....	.....	3013	Gord. oil.....	462
904	6	2211	2930	3042	.....	.....	3139	30-ft. and Gord. gas show; Gord. and Stray oil show	463
895	7	2186	.....	2992	.....	.....	3015	Gord. oil.....	464
1035	.....	2328	.....	3117	.....	.....	3138	Gord. oil.....	465
1225	5	2525	.....	.....	.....	.....	3339	Gord. oil.....	466
1064	6	2350	.....	3165	.....	.....	3202	Gord. oil.....	467
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole.....	468
815	6	2182	2860	2972	.....	.....	3317	Max. oil; 50-ft. gas.....	469
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	470
955	10	2274	2950	3101	.....	.....	3122	B. I. gas; 30-ft. & Gord. oil	471
734	5	.....	.....	.....	.....	.....	1943½	Maxton oil	472
972	5	2300	2976	3121	.....	.....	3146	Gord. oil, 30-ft. oil show	472A
837	4	2176	.....	.....	.....	.....	2975	50-ft. & Stray gas	473
940	.....	2222	.....	3051	.....	.....	3742½	B. I. & Gord. oil show..	474
823	9	2109	.....	2938	.....	.....	3324	Gord. oil and gas, 50-ft. gas	475
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil	476
.....	.....	.....	.....	.....	.....	.....	.....	30-ft. oil	477
660	9	.....	.....	.....	.....	.....	1607	Moundsville gas	478
.....	.....	.....	.....	.....	.....	.....	.....	———	479
843	8	2135	.....	2950	.....	.....	2997	Gordon oil	480
935	.....	.....	.....	.....	.....	.....	.....	———	481
1053	10	2326	.....	3130	.....	.....	3164	B. I. gas; Gord. oil	482
1225	6	2501	3200	3311	.....	.....	3375	50-ft. oil and gas	483

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
484	Mary E. Price No. 1	Mannington	Delmar	1200B
485	B. F. Robinson No. 1	Mannington	Delmar	1155B
486	A. J. Ice, Jr., No. 1	Mannington	Delmar	1135B
487	Daniel Varner No. 1	Mannington	Burt	1155B
488	F. M. Fluharty No. 1	Mannington	Burt	1150B
489	Columbus Snodgrass No. 1	Mannington	Burt	990B
490	Thornton Fluharty No. 1	Mannington	Burt	1055B
491	Alfred F. Sine No. 3	Mannington	Greenlee & Co.	980L
492	M. A. Morgan No. 2	Mannington	Hartman	985B
493	Nimrod Morgan No. 7	Mannington	Hartman	984B
494	Nimrod Morgan No. 5	Mannington	Hartman	977B
495	Paddy Hopkins No. 2	Mannington	Burt	972B
496	Paddy Hopkins No. 1	Mannington	Burt	976B
497	George Furbee No. 1	Mannington	Marsh	981L
498	James Fluharty No. 1	Mannington	South Penn	1305B
499	E. Wilson No. 1	Mannington	South Penn	1180B
500	C. A. Kuhn No. 1	Mannington	South Penn	1195B
501	Ozias Kuhn No. 1	Mannington	South Penn	....
502	B. F. Blackshere No. 15	Mannington	South Penn	1250B
503	Watson Heirs No. 1	Mannington	South Penn	1090B
504	Francis Snodgrass No. 1	Mannington	South Penn	1225B
505	F. H. Burt No. 15	Mannington	Burt	1000B
506	F. H. Burt No. 1	Mannington	Burt	962L
507	F. H. Burt No. 16	Mannington	Burt	1087L
508	F. H. Burt No. 14.	Mannington	Burt	1057L
509	F. H. Burt No. 6	Mannington	Burt	970L
510	Erwin-Prichard No. 1	Mannington	South Penn	1020B
511	N. S. Beaty No. 1	Mannington	South Penn	985B
512	G. M. Floyd No. 1	Mannington	South Penn	1000B
513	R. P. Floyd No. 1	Mannington	U. S. Oil	1135B
514	Jefferson Holbert No. 1	Mannington	South Penn	1490B
515	J. W. Conaway No. 3	Mannington	South Penn	1064B
516	Michael Kennedy No. 1	Mannington	South Penn	1090B
517	John Kennedy No. 2	Mannington	South Penn	1120B
518	Koen & Pritchard No. 1	Mannington	Hartman	1380B
519	J. C. Straight No. 2	Mannington	South Penn	1140B
520	Z. Kendall No. 3	Mannington	Hartman	1370B
521	Z. Kendall No. 2	Mannington	Hartman	1380B
522	Z. Kendall No. 1	Mannington	Hartman	1385B
523	S. M. Tetrick No. 2	Mannington	Hartman	1475B
524	S. M. Tetrick No. 1	Mannington	Hartman	1425B
525	Martha B. Shafer No. 2	Mannington	Chartiers	1275B
526	Henry Tetrick No. 5	Mannington	Hope	1160B
527	Wm. Wright No. 1	Mannington	South Penn	1270B
528	L. J. Hall No. 1	Mannington	———	1225B
529	P. G. Hall No. 3	Mannington	———	1160B
530	P. Gaughan No. 1	Mannington	South Penn	....
531	John N. Hall No. 1	Mannington	South Penn	1155B

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
1105	6	2395	.....	3186	.....	.....	3210	Stray oil and gas	484
1002	8	.....	.....	3117	.....	.....	3158	Gord. oil	485
1020	.....	2310	.....	3105	.....	.....	3143	Stray & Gord. oil	486
710	.....	.....	.....	.....	.....	.....	2170	B. I. oil; B. Lime gas...	487
735	7	2040	.....	2925	2978	.....	3002	Gordon gas	488
608	9	1921	.....	2843	2857	.....	2937	B. Dunk gas.	489
575	5	1914	.....	2796	2825	.....	3035	50-ft. gas	490
.....	.....	.....	.....	.....	.....	.....	.....	———	491
505	.....	1956	.....	.....	2727	.....	2736	———	492
482	.....	1775	.....	2645	2699	.....	2714	B. I. gas; 4th oil	493
462	.....	1780	.....	.....	2681	.....	.....	4th oil	494
463	.....	.....	.....	.....	2678	.....	.....	4th oil	495
464	.....	.....	.....	.....	.....	.....	.....	4th oil and Gnz. & 50-ft. gas	496
441	11	1755	.....	.....	.....	.....	.....	B. I. & Squaw gas	497
818	.....	2155	.....	.....	.....	.....	2254	B. I. oil	498
696	6	2040	.....	.....	2924	.....	2973	Gnz. and 4th gas	499
696	.....	2017	.....	2918	2952	.....	3132	4th gas	500
668	7	1980	.....	.....	2896	.....	2924	B. I., 50-ft., 4th gas....	501
632	7	1990	.....	.....	.....	.....	2125	B. I. gas and oil.....	502
484	.....	1843	.....	.....	.....	.....	1949	B. I. oil	503
.....	.....	.....	.....	.....	.....	.....	.....	———	504
445	.....	1788	.....	.....	.....	.....	1896	B. I. oil	505
.....	.....	.....	.....	.....	.....	.....	.....	B. Dunk. gas; B. I. oil...	506
328	10	1872	.....	.....	.....	.....	1975	B. I. oil	507
510	.....	1838	.....	2723	.....	.....	3000	B. I. & 4th oil	508
415	.....	1755½	.....	.....	.....	.....	1849½	B. I. oil	509
.....	.....	.....	.....	2660	2694	.....	2741	4th oil	510
.....	.....	.....	.....	.....	.....	.....	.....	———	511
497	.....	1845	.....	2705	.....	.....	2740	4th oil; 50-ft. gas	512
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. gas; 4th oil.....	513
.....	.....	.....	.....	.....	.....	.....	3228	4th oil, very large.....	514
508	6	1835	.....	.....	2710	.....	2715	Gnz. gas, 4th oil	515
551	10	1908	.....	.....	2751	.....	2764	4th oil, large well.....	516
590	10	1924	.....	.....	2780	.....	2788	B. I. gas & oil; 4th oil ..	517
795	.....	2162	.....	.....	.....	.....	2254	B. I. oil	518
552	10	1900	.....	.....	2758	2816	3042	B. I. gas show; 4th oil..	519
779	8	2145	.....	.....	.....	.....	2255	B. I. oil	520
785	.....	2157	.....	.....	.....	.....	2245	B. I. oil	521
782	.....	2161	.....	.....	.....	.....	2304	B. I. oil	522
878	.....	2244	.....	.....	.....	.....	2336	B. I. oil	523
817	.....	2194	.....	.....	.....	.....	2295	B. I. oil	524
737	.....	.....	.....	.....	2935	.....	2955	4th oil	525
570	.....	1900	.....	2759	2806	.....	2826	Gord. gas	526
740	8	2054	.....	.....	2910	.....	2938	50-ft. gas, 4th oil, large.	527
.....	.....	2000	.....	2873	2900	2950	3012	B. I. oil show, Gnz. gas.	528
603	9	1943	.....	2758	2779	.....	2807	B. I. & 4th oil, 50-ft. gas.	529
584	8	1900	2625	.....	.....	.....	2857	B. I., Gnz. & 30-ft. gas shows	530
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil	531

Summarized Record of

Map No	NAME OF WEL	Location—District	OWNER	Elevation A. T.
532	Koen Bros. No. 1	Mannington	Huey et al.	1130B
533	S. E. Snyder No. 1	Mannington	South Penn	1030B
534	E. C. Morgan No. 1	Mannington	South Penn	1455B
535	Abram Ashcraft No. 1	Mannington	South Penn	1230B
536	Lindsay Blaker No. 1	Mannington	South Penn	1115B
537	Lindsay Blaker No. 2	Mannington	South Penn	1100B
538	W. P. Mason No. 1	Mannington	South Penn	1013L
539	W. P. Mason core test	Mannington	J. V. Thompson	1005L
540	Daniel Mason No. 1	Mannington	South Penn	1025B
541	Fleming Hamilton No. 1	Mannington	A. J. Montgomery	1055B
542	G. R. Morgan No. 1	Mannington	South Penn	1060B
543	M. S. Snodderly No. 1	Mannington	South Penn	1205B
544	Chas. Hibbs No. 1	Mannington	South Penn	....
545	R. J. Martin No. 1	Mannington	Phila	1080B
546	G. L. Fortney No. 1	Mannington	Hope	1115B
547	Dudley Robinson No. 1	Mannington	Carnegie	1135B
		Eagle		
548	John Mason No. 1	(Harrison Co.)	South Penn	1010B
549	H. L. Jones No. 1	Mannington	Hope	1530L
550	J. A. Wadsworth No. 1	Mannington	Phila	1125B
551	Noah Price No. 1	Pawpaw	South Penn	1600B
552	Jos. Michael No. 1	Pawpaw	South Penn	1300B
553	P. B. Amos No. 11	Pawpaw	Fisher	1105B
554	David Jones No. 1	Pawpaw	South Penn	1018L
555	Brice Wallace No. 1	Pawpaw	South Penn	1135B
556	David Jones No. 5	Pawpaw	South Penn	....
557	G. W. Toothman No. 5	Pawpaw	South Penn	....
558	G. W. Toothman No. 1	Pawpaw	South Penn	1035B
559	Jas. Yost No. 8	Pawpaw	South Penn	1030B
559A	H. S. Basnett No. 1	Pawpaw	Phila	1040B
560	P. W. Yost No. 1	Pawpaw	Ira DeWitt	1030B
561	Mary Burns No. 2	Pawpaw	Consolidation	1005B
562	L. N. Yost No. 5	Pawpaw	Consolidation	1010B
563	J. G. Eddy No. 1	Pawpaw	South Penn	1075B
564	Alice (Kuhn) Lamberton No. 1	Pawpaw	Carnegie	1140B
565	Silas Wilson Heirs No. 1	Pawpaw	Fairmont	1220B
566	G. W. Brown No. 1	Pawpaw	Fisher	1185B
567	Jas. Eddy No. 1	Pawpaw	Hope	1280B
568	Jeff. Wilson No. 1	Pawpaw	Fairmont	1060B
569	Jas. Eddy No. 1	Pawpaw	Carnegie	1065B
570	Jacob A. Mason No. 1	Pawpaw	Carnegie	1148L
571	A. T. Hibbs No. 1	Pawpaw	Hope	1020B
572	W. R. Toothman No. 1	Pawpaw	Carnegie	1215B
573	J. E. Michael No. 1	Pawpaw	Hope	1040B
574	W. G. King No. 1791	Pawpaw	Hope	972L
575	H. C. B. Hall No. 1	Pawpaw	Wheeling	1120B
576	A. S. Kennedy No. 1	Pawpaw	Benedum & Trees	1010B
577	Ulyses M. Price No. 1	Pawpaw	Hope	....
578	Jonathan Eddy No. 1	Pawpaw	Hope	1050B
579	John H. Ammons coal test	Pawpaw	———	980B

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	532
560	8	1858	.....	.....	.....	.....	3014	———	533
882	8	2214	2920	3052	.....	.....	.....	B. I. oil; Gord. gas.....	534
635	.....	1950	2670	2805	2845	.....	2889	Gord. gas	535
530	8	1857	.....	.....	.....	.....	1965	B. I. oil and gas	536
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. gas; B. I. & 4th oil.	537
.....	.....	.....	.....	.....	.....	.....	.....	———	538
.....	.....	.....	.....	.....	.....	.....	.....	———	539
475	9	1805	.....	2600	2675	.....	2759	50-ft. gas	540
459	11	1803	.....	.....	.....	.....	1928	B. I. oil	541
475	.....	1842	.....	.....	.....	.....	1943	B. I. oil & gas, light.....	542
637	.....	1972	.....	.....	.....	.....	2107	Salt gas; B. I. oil.....	543
.....	.....	.....	.....	.....	.....	.....	.....	———	544
380	.....	1745	.....	2520	2611	.....	3007	B. I. & 30-ft. gas.....	545
430	.....	1750	.....	2600	.....	.....	2655	Gordon gas	546
440	.....	1750	.....	.....	.....	.....	.....	———	547
228	.....	1600	.....	2418	2437	.....	2495	Gord. & 4th gas	548
.....	.....	.....	.....	.....	.....	.....	.....	5th gas	549
285	.....	1632	.....	.....	.....	.....	2684	B. I., Squaw, 50-ft. Stray.	550
1263	.....	2565	.....	.....	3468	.....	3493	Gnz. gas; 4th oil	551
.....	.....	.....	.....	.....	.....	.....	.....	Big I. oil show.....	552
602	.....	1910	.....	.....	2840	.....	3028	6th oil	553
473	.....	1819	.....	.....	.....	.....	1929	B. I. oil	554
520	14	1850	.....	.....	.....	.....	1997	B. I. oil	555
695	9	1990	.....	.....	.....	.....	3143	B. I. and 6th oil.....	556
575	.....	1915	.....	.....	.....	.....	2022	B. I. oil—1000 bbls.....	557
.....	.....	1780	.....	.....	.....	.....	1917	B. I. oil	558
420	.....	1790	.....	.....	.....	.....	1892	B. I. oil	559
355	7	1670	.....	2552	.....	.....	2793	B. I. and 6th oil.....	559A
462	10	1785	.....	.....	.....	.....	.....	B. I. and "Gas" oil	560
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil	561
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil	562
.....	.....	.....	.....	.....	.....	.....	.....	B. I. oil	563
465	7	1752	.....	.....	.....	.....	.....	6th gas	564
.....	.....	.....	.....	.....	.....	.....	.....	———	565
464	.....	1892?	.....	.....	2685	.....	2929	———	566
622	.....	1910	.....	.....	.....	.....	1944	B. I. gas	567
.....	.....	.....	.....	.....	.....	.....	.....	———	568
400	.....	1680	.....	.....	.....	2747	2821	B. I., Berea, 6th gas...	569
497	.....	.....	.....	.....	.....	.....	.....	———	570
316	.....	1614	2343	2495	2530	2595	2750	B. I., 30-ft. & 5th gas ...	571
490	.....	1840	2485	2710	.....	2786	2868	B. I., 30-ft. & 5th gas...	572
319	.....	.....	.....	.....	.....	.....	.....	B. I., and 5th gas.....	573
242	.....	1570	2250	2425	none	.....	2745	B. I. 30-ft. and 6th gas..	574
405	.....	.....	.....	.....	.....	.....	.....	———	575
385	.....	1681	.....	2505	.....	.....	2823	B. I. gas, light.....	576
800	.....	2127	.....	2950	3090	.....	3445	B. I. gas, 6th oil.....	577
390	.....	1680	.....	.....	.....	.....	1811	B. I. gas	578
.....	.....	.....	.....	.....	.....	.....	.....	———	579

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
580	Frank Arnett No. 1	Pawpaw	Hukill	1020B
581	Alpheus (J. L.) Fluharty No. 1	Pawpaw	Hope	1030B
582	H. B. Amos No. 1	Pawpaw	Wheeling	1123B
583	D. L. Toothman No. 1	Pawpaw	Hope	1185B
584	Jas. Brand No. 1	Pawpaw	Hope	1205B
585	J. W. Williams No. 1	Pawpaw	W. Va. T. & E.	1199L
586	O. L. Smith et al. No. 1	Pawpaw	W. Va. T. & E.	1200B
587	Wm. R. Clayton No. 1	Pawpaw	Clayton	925B
588	New Central Coal Co. No. 3.	Pawpaw	New Central	910B
589	Wm. Wallace No. 2	Lincoln	Hope	1210B
590	M. V. Millan No. 1	Lincoln	Phila	1155B
591	Wm. Wallace No. 1	Lincoln	Hope	1110B
592	W. M. Billingslea No. 1	Lincoln	South Penn	1095B
593	J. A. Holbert No. 1	Lincoln	South Penn	1055B
594	Benj. Huffman No. 3	Lincoln	South Penn	1075B
595	Eli T. Price No. 1	Lincoln	South Penn	....
596	A. O. Talkington No. 2	Lincoln	South Penn	1155B
597	A. O. Talkington No. 7	Lincoln	South Penn	1105B
598	A. O. Talkington No. 1	Lincoln	South Penn	1135L
599	Rezin Amos No. 1	Lincoln	Jackson et al.	1117L
600	L. D. Martin No. 1	Lincoln	Fayette	....
601	E. M. Parish No. 1	Lincoln	South Penn	1300B
602	N. Beaty No. 20	Lincoln	McCune	1145B
603	N. Beaty No. 17	Lincoln	McCune	1170B
604	N. Beaty No. 10	Lincoln	McCune	1065B
605	John Eagan No. 3	Lincoln	Brown & Co.	1310B
606	Festus Downs No. 4	Lincoln	Brown & Co.	1100B
607	F. (O. M.) Freeland No. 1	Lincoln	Phila.	981L
608	Albert Pyles	Lincoln	Fairmont	1065B
609	Miller Heirs	Lincoln	Hope	1150B
610	Hunter Atha No. 1	Lincoln	Fayette	1050B
611	Sallie Martin coal test	Lincoln	Cons. coal	1010L
612	Jack Connor No. 1	Lincoln	Fayette	1045B
612A	I. M. Lough No. 1	Lincoln	Hope	1415B
613	Wm. Barrackman No. 1	Lincoln	———	1125B
614	Geo. Price No. 4	Lincoln	———	1025B
615	E. W. Hamilton No. 1	Lincoln	Hope	1220B
616	E. W. Hamilton No. 1	Lincoln	McCune	1060B
617	Eliza Brand Heirs No. 1	Lincoln	Hope	1115B
618	Plum Run coal test	Lincoln	———	....
619	Annie Cunningham No. 1	Lincoln	Carnegie	1060B
620	R. Martin No. 1	Lincoln	Carnegie	955B
621	Morgan-Fox coal test No. 14	Lincoln	Cons. coal	998L
622	A. B. Morgan No. 1	Lincoln	Carnegie	1150B
623	Jessie B. Martin coal test No. 10	Lincoln	Cons. coal	936L
624	John W. Criss No. 1	Lincoln	Carnegie	975B
625	E. T. Wood coal test No. 3	Lincoln	Pgh.-Buffalo	974L
626	H. L. Sturm No. 1	Lincoln	Hope	1115B

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	———	580
338	8	1663	2360	2553	.....	2682	3065	B. I. gas	581
410	.....	.....	.....	.....	.....	.....	.....	———	582
505	.....	1842	.....	2700	2786	2852	2854	B. I. and 5th gas.....	583
.....	.....	.....	.....	.....	.....	.....	.....	———	584
488	7	1856	2524	2707	2765	2871	3025	B. I., Gnz. & "Gas" gas..	585
477	7	.....	.....	.....	.....	.....	.....	B. I. gas	586
.....	.....	.....	.....	.....	.....	.....	40	Arnoldsburg gas	587
.....	.....	.....	.....	.....	.....	.....	125?	Sewickley coal gas	588
747	.....	2087	.....	.....	2952	3017	3138	B. I., 5th, 6th gas.....	589
640	.....	1915	.....	2830	2868	.....	2886	4th gas	590
590	11	1912	.....	.....	.....	.....	.....	———	591
542	.....	1850	.....	.....	.....	.....	1975	B. I. oil	592
512	.....	1860	.....	.....	.....	.....	1960	B. I. oil	593
544	8	1887	.....	.....	.....	.....	2010	B. I. oil	594
860	10	2190	.....	.....	.....	.....	2314	B. I. oil	595
565	10	1910	.....	.....	.....	.....	2040	B. I. oil	596
510	.....	1852	.....	.....	.....	.....	1960	B. I. oil	597
521	.....	1857	.....	.....	.....	.....	1994	B. I. oil	598
510	7	1855	.....	.....	.....	.....	1959	B. I. oil	599
670	.....	2005	.....	.....	.....	.....	2160	B. I. oil	600
715	7	2065	.....	.....	.....	.....	2191	B. I. oil	601
575	.....	1905	.....	.....	.....	.....	2032	B. I. oil	602
600	.....	.....	.....	.....	2850	.....	3060	B. I. oil; 4th & 6th gas.	603
.....	.....	.....	.....	.....	.....	.....	.....	———	604
715	.....	.....	.....	.....	2947	.....	3136	B. I. oil; 4th & 6th gas..	605
485	.....	.....	.....	.....	2718	.....	2735	B. I. & 4th oil.....	606
.....	.....	.....	.....	.....	.....	.....	.....	———	607
354	.....	.....	.....	.....	.....	2733	.....	5th gas	608
465	.....	1795	.....	.....	2685	2840	2859	B. I & 5th gas	609
357	10	1718	.....	.....	2560	2605	2750	B. I. & Bayard gas.....	610
.....	.....	.....	.....	.....	.....	.....	.....	———	611
368	.....	1710	.....	.....	2575	.....	2757	Bayard gas	612
768	.....	2115	.....	.....	3008	3150	3184	B. I. & 5th gas.....	612A
.....	.....	.....	.....	.....	.....	.....	.....	———	613
.....	.....	.....	.....	.....	.....	.....	.....	———	614
600	.....	1937	.....	.....	2835	.....	3025	B. I., 50-ft., 4th & 6th gas	615
.....	.....	.....	.....	.....	.....	.....	.....	———	616
475	.....	1816	.....	2688	2717	.....	2882	B. I. gas	617
.....	.....	.....	.....	.....	.....	.....	.....	———	618
.....	.....	.....	.....	.....	.....	.....	.....	———	619
.....	.....	.....	.....	.....	.....	.....	.....	———	620
324	8'2"	.....	.....	.....	.....	.....	332½	———	621
470	9'	1844	2556	2690	2735	2856	2916	5th gas	622
234	10	.....	.....	.....	.....	.....	245½	———	623
275	9	1656	.....	2479	2573	2695	2714	5th gas	624
288	8'2"	.....	.....	.....	.....	.....	296¼	———	625
435	.....	1830	.....	2645	2710	2838	2856	5th gas	626

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
627	Jas. Morgan (Silas Stark) No. 1894	Lincoln	Phila	1112L
628	D. C. Jones No. 2449	Mannington	Phila.	1245B
629	H. R. Glover No. 1885	Mannington	Phila	1210B
629A	I. N. Ashcraft coal test	Mannington	Pgh.-Buffalo	....
630	M. M. Martin No. 2121	Lincoln	Phila.	1045B
631	Joshua Hess No. 1	Lincoln	Hope	1240B
632	J. N. (Nancy) Cunningham No. 1889.	Lincoln	Phila.	997L
632A	J. N. Cunningham coal test	Lincoln	Pgh.-Buffalo	....
633	L. H. Tetrick No. 1	Lincoln	Hope	1290B
634	Margarette Parrish No. 923	Lincoln	Hope	1235B
634A	Absalom Martin coal test No. 1	Lincoln	Pgh.-Buffalo	1122L
635	A. A. Parrish No. 805	Lincoln	Hope	1285B
636	John E. Parrish No. 787	Lincoln	Hope	1150B
637	E. T. Martin No. 1565	Lincoln	Hope	1135B
638	W. S. Parrish coal test No. 11	Lincoln	Cons. coal	1082L
639	W. S. Parrish No. 2197	Lincoln	Hope	1240B
639A	Olive Minnear coal test No. 2	Lincoln	Pgh.-Buffalo	1007L
640	A. Martin No. 2165	Lincoln	Hope	1155B
640A	Jane Downs coal test No. 4	Lincoln	Pgh.-Buffalo	1064L
641	Mattie C. Sturm No. 1	Lincoln	Phila.	1035B
641A	B. D. Holbert coal test	Lincoln	Pgh.-Buffalo	....
642	E. H. Stevens No. 2138	Lincoln	Phila.	1033L
643	Mary Hawkins coal test No. 13	Lincoln	Cons. coal	946L
644	Clement Davis No. 1	Lincoln	Carnegie	1143B
645	L. L. Kuhn No. 1	Lincoln	Fayette	1050B
646	Z. F. Davis coal test No. 4	Lincoln	Cons. coal	965L
647	W. P. Fortney coal test No. 3	Lincoln	Cons. coal	918L
648	John N. Woods No. 1	Lincoln	Hope	1410B
649	Felix Cunningham No. 2269.	Lincoln	Phila.	1224B
650	J. S. Billingslea No. 1	Lincoln	Phila.	1220B
651	Marvin Tetrick (Eleon Straight) No. 2148	Lincoln	Phila.	1220B
652	Nancy Billingsley coal test No. 5	Lincoln	Cons. coal	994L
653	Wm. F. Sandy coal test No. 12	Lincoln	Cons. coal	1101L
654	J. L. Davis coal test	Lincoln	Georges Creek	926B
655	Curtis Fletcher coal test No. 9	Lincoln	Cons. coal	918L
656	Vanzandt Heirs No. 1	Lincoln	Phila	950B
657	May Downs No. 1	Lincoln	Phila.	1305B
658	Geo. I. Ensminger No. 2343	Lincoln	Phila.	1125B
659	Nancy Martin coal test No. 6	Lincoln	Cons. coal	998L
660	J. L. Jones coal test No. 2	Lincoln	Cons. coal	1202L
661	Curtis Davis No. 1	Lincoln	Carnegie	1240B
662	W. C. Kuhn No. 1	Lincoln	Hope	1170B
663	E. C. Morgan coal test No. 1	Lincoln	Cons. coal	....
664	Eli M. Rex No. 1	Fairmont	Hope	1070B
665	Lewis Hall No. 1	Fairmont	Phila.	1065B
666	A. Boutlou No. 1	Fairmont	A. Bowen	950B

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
328	.....	1680	.....	.....	.....	.....	1713	B. I. gas	627
606	9′	1976	.....	.....	.....	.....	2077	———	628
560	13	.....	.....	.....	.....	.....	.....	———	629
.....	.....	.....	.....	.....	.....	.....	.....	———	629A
300	5	1690	.....	2512	2683	2687	2687	4th oil & gas; 5th gas..	630
480	.....	1866	.....	2697	2722	2861	2917	Gord., 5th gas	631
179	10	.....	.....	.....	.....	.....	.....	———	632
.....	.....	.....	.....	.....	.....	.....	.....	———	632A
375	.....	1797	.....	2610	2655	2790	3200	5th gas	633
.....	.....	.....	.....	.....	.....	.....	.....	———	634
437	7	.....	.....	.....	.....	.....	.....	———	634A
600	8	1971	.....	2836	2875	2993	3055	B. I. & 30-ft. gas	635
.....	.....	.....	.....	.....	.....	.....	.....	———	636
435	.....	1822	.....	2597	2696	2808	2830	5th gas	637
389	9′9″	.....	.....	.....	.....	.....	400	———	638
570	7′	1965	2565	2767	2805	2957	3032	50-ft. and 5th gas.....	639
268	7	.....	.....	.....	.....	.....	.....	———	639A
400	7	1788	2428	2587	2627	2790	2692	B. I. & 5th gas	640
329	8	.....	.....	.....	.....	.....	.....	———	640A
175	.....	1580	.....	2382	2412	2575	2613	5th gas	641
.....	.....	.....	.....	.....	.....	.....	.....	———	641A
190	4	1630	.....	2410	.....	2590	2613	5th gas	642
65	8′11½″	.....	.....	.....	.....	.....	77	———	643
.....	.....	.....	.....	.....	.....	.....	.....	———	644
.....	.....	.....	.....	.....	.....	.....	.....	———	645
198	9′5″	.....	.....	.....	.....	.....	208	———	646
183	9′1½″	.....	.....	.....	.....	.....	192¼	———	647
620	.....	2025	.....	2810	2895	2986	3006	5th gas	648
500	.....	1900	.....	2715	.....	2866	2910	5th gas	649
477	.....	1865	.....	.....	2824	2848	2908	4th and 5th gas	650
460	.....	1863	.....	2690	.....	2845	2881	5th gas	651
197	9′10″	.....	.....	.....	.....	.....	208⅓	———	652
272	10′6″	.....	.....	.....	.....	.....	283¼	———	653
228	9′	.....	.....	.....	.....	.....	237	———	654
198	9′6″	.....	.....	.....	.....	.....	209¾	———	655
255	.....	1576	.....	2485	2540	2643	2862	B. I. & 5th gas.....	656
.....	.....	.....	.....	.....	.....	.....	.....	———	657
390	.....	1748	.....	2655	2687	2767	2912	B. I. & 5th gas	658
217	9′8½″	.....	.....	.....	.....	.....	228	———	659
461	8′	.....	.....	.....	.....	.....	470⅔	———	660
.....	.....	.....	.....	.....	.....	.....	.....	———	661
.....	.....	1697	.....	.....	.....	.....	1715	B. I .gas	662
.....	.....	.....	.....	.....	.....	.....	.....	———	663
365	10	1735	2455	2550	2600	2655	2873	Dry hole	664
417	9	1775	2483	2606	2667	2759	3027	Dry hole	665
235	8	1658	.....	2377	.....	2600	.....	———	666

Summarized Record of

Map No.	NAME OF WELL	Location — District	OWNER	Elevation A. T.
667	John Gollohue No. 1	Fairmont	Hukill	915B
668	Conoway, Hamilton & Erwin No. 1	Fairmont	Carnegie	940B
669	Morgan-Billingslee coal test No. 8	Fairmont	Cons. coal	914L
670	Wm. Straight No. 1	Fairmont	Thos. Miller ?	930B
671	Andrew Ice No. 1	Fairmont	Thos. Miller ?	885B
672	Shore coal test No. 7	Fairmont	Cons. coal	984L
673	Millard Boggess No. 1	Fairmont	Phila.	940B
673A	Andrew Riggs No. 1	Fairmont	Phila	955B
674	Wm. Watson No. 1	Grant	J. M. Guffey	885B
675	Doyle (Louanna) Everson No. 1	Grant	Phila.	993B
676	Presley Ogden No. 1	Grant	Phila.	919L
677	John Wright No. 1	Grant	National	945L
678	J. Lee Bice No. 1	Grant	Hog Lick	1020B
679	Frank Boice No. 1	Grant	Hope	950B
680	Harriet Frum No. 1	Grant	Grant Dev.	995B
681	Davis Heirs No. 1	Grant	Fitch et al.	1156L
682	F. M. Meredith No. 1	Winfield	Miller & Co.	1100B
682A	Brent S. Jones No. 1	Winfield	Hope	985B
683	Vincent Heirs No. 2010	Winfield	Hope	1114L
684	John M. Turner No. 1	Winfield	———	1110B
684A	Amos Huffman No. 1	Winfield	Hope	....
685	Rogers & Lake No. 1	Union	———	1115B
685A	Hiram Linn No. 1	Union	Excelsior	....
686	Harris L. Jolliffe No. 1	Union	Madera et al.	975B
687	W. R. Jasper Heirs No. 1	Union	McDonald et al.	926L
688	J. F. Vangilder No. 1	Union	Miller & Co.	975B
688A	Edwin Nuzum No. 2504	Union	Hope	....

Wells in Marion County—Continued.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	———	667
.....	.....	.....	.....	.....	.....	.....	.....	———	668
218	9′11¼″	.....	.....	.....	.....	.....	229½	———	669
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	670
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	671
274	10′	.....	.....	.....	.....	.....	.....	———	672
.....	.....	.....	.....	.....	.....	.....	.....	———	673
.....	.....	.....	.....	.....	.....	.....	.....	B. I. & 5th gas.....	673A
5	.....	.....	.....	.....	.....	.....	.....	Dry hole	674
28	.....	1450	.....	.....	.....	2395	2505	B. I. & 6th gas.....	675
.....	.....	.....	.....	.....	.....	.....	.....	———	676
40	.....	.....	.....	.....	.....	.....	.....	———	677
0	.....	1483	2100	2206	.....	2392	2569	B. I., 50-ft. & 6th gas...	678
.....	.....	1380	.....	2077	.....	2280	2323	B. I., 50-ft. gas	679
.....	.....	1367	.....	2080	.....	2323	2434	Squaw oil	680
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	681
.....	.....	1410	.....	.....	.....	2363	2490	———	682
.....	.....	845	.....	1595	1690	1775	2539	———	682A
.....	.....	658	1313	.....	.....	1639	3400	B. I. gas, light	683
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	684
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	684A
.....	.....	.....	.....	.....	.....	.....	1209	Gas show	685
.....	.....	960	.....	.....	.....	.....	2019	Speechley gas show	685A
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	686
.....	.....	1000	1560	1700	.....	.....	2347	Dry hole	687
.....	.....	1290	1870	2015	.....	2269	2384	B. I. oil show; 5th & 6th gas	688
.....	.....	992	.....	1843	1909	2015	2926	Dry hole	688A

For the same reasons as given on the page immediately following the Monongalia table of wells, the complete records of a number of the borings in Marion will now be given and discussed. The serial number is published not only in the foregoing table, but along with the heading in parenthesis when the complete log is given, as well as on Map II.

Mannington District.

Mannington district occupies the western portion of Marion county and its entire area lies in the Robinson Basin, but by far the greater portion along the eastern flank of this trough. This district has produced more oil than all the remaining part of the county, the main producing sands being the Big Injun, Thirty-foot, Gordon and Fourth. The principal gas producing areas are confined to those portions of the district that have a comparatively high structural level, or along the western border and in the southeast corner. A discussion of the several oil and gas pools and the logs of wells therein will now be taken up roughly from west to east across the district.

Along the western edge of Mannington district there occur 20 to 25 gas wells on the eastern flank of the Hundred anticline. The three following records from scattered borings in this field show that the main producing sands are the Maxton, Big Injun and Fourth:

Geo. T. Hamilton No. 1 Well Record (359).

Mannington district, 2.7 miles northwest of Seven Pines. Authority, Carnegie Natural Gas Company. Completed Oct. 16, 1909.

(Elevation, 1235′ B.A.T.)	Thickness Feet.	Total Feet.
Unrecorded	1060	1060
Pittsburgh coal	8	1068
Unrecorded	1262	2270
Big Injun sand (little water, 1769′; small oil show, 2130′; little gas, 2330.; big gas, 2337′) and unrecorded to bottom	85	2355

10″ casing, 188′; 6⅝″ casing, 2222′; 3″ tubing, 2355′. Packed with Anchor Packer at 2300′. 0.8 mercury in 6⅝″ casing.

The mercury gage test is equivalent to a 5,450,000 cu. ft. of gas daily.

Calvin Hamilton No. 1 Well Record (362).

Mannington district, 2.3 miles northwest of Seven Pines. Authority, Carnegie Natural Gas Company. Completed Oct. 12, 1907.

(Elevation, 1235′ B-A.T.)	Thickness Feet.	Total Feet
Unrecorded	990	990
Coal, Pittsburgh	8	998
Unrecorded	1116	2114
Maxton sand	100	2214
Unrecorded	58	2272
Big Injun sand (gas, 2276′ and 2293′)	180	2452
Unrecorded	298	2750
Sand, Gantz? (Berea)	70	2820
Unrecorded	85	2905
Fifty-foot sand	45	2950
Unrecorded	68	3018
Gordon Stray sand	38	3056
Unrecorded	18	3074
Gordon sand (gas, 3104′, steel line measurement)	59	3133
Unrecorded	14	3147
Fourth sand (big gas, 3158′, steel line measurement)	30	3177
Unrecorded to bottom	0′8″	3177′8″

10″ casing. 198′; 8¼″ casing, 1421′; 6⅝″ casing, 2330′; 3″ tubing, 2778′.

Pressure test in 3″ tubing:

1st ½ minute, 160 lbs.	15th minute. 765 lbs.
1st minute, 210 lbs.	30th minute, 790 lbs.
4th minute, 500 lbs.	

Later test in 3″ tubing:

1st ½ minute, 240 lbs.	5th minute, 750 lbs.
1st minute, 320 lbs.	10th minute, 820 lbs.
2nd minute, 500 lbs.	20th minute, 865 lbs.
3rd minute, 620 lbs.	Two hours, 940 lbs.
4th minute, 700 lbs.	Rock pressure, 980 lbs.

In the above record the Pittsburgh coal—Fourth sand interval is 40 to 60 feet less than in the central and eastern portions of Mannington district, owing to the general westward thinning of the Carboniferous measures.

James Toothman No. 1 Well Record (364).

Mannington district, 1.4 miles north of Brink. Authority, Hope Natural Gas Company. Completed in 1911.

(Elevation, 1355′ B-A.T.)	Thickness Feet.	Total Feet.
Unrecorded	750	750
Bluff sand and unrecorded	210	960
Coal, Mapletown (Sewickley)	6	966
Unrecorded	94	1060
Pittsburgh coal	..	1060

	Thickness. Feet.	Total. Feet.
Unrecorded	470	1530
Big Dunkard sand	50	1580
Unrecorded	120	1700
Gas sand	80	1780
Unrecorded	40	1820
Salt sand (water, 1880′)	70	1890
Unrecorded	5	1895
Second Salt sand (water, 1900′ and 1930′)	50	1945
Red rock	230	2175
Maxton sand (gas, 2182′-2193′; shell, 2194′; gas increase, 2194′-2197′) to bottom	22	2197

10" casing, 1387′; 8¼" casing, 2000′; 2/10 mercury in 8¼" casing.

The mercury test is equivalent to 4,225,000 cu. ft. of gas daily, a very good production from the Maxton.

On the headwaters of Buffalo creek to the northwest of Glover Gap there occurs a pool of 45 to 50 oil wells in the Thirty-foot sand down near the axis of the Robinson Basin in ideal conformity with the anticlinal theory of the accumulation of oil and gas, since the latter sand is non-water bearing in this part of the State. Development in this field started about five years ago, the initial oil production of the wells ranging from 10 to 200 barrels. The wells fell off rapidly, however, from their first production, so that not so much profit was made by the operators as in the Big Injun, Gordon and Fourth sand pools in the same district. The three following records from wells in this field give interesting data with reference to the sands and the minable coals:

L. A. Keenan No. 1 Well Record (348).

Mannington district, 1.9 miles N 30° W of Glover Gap. Authority, South Penn Oil Company. Completed May 2, 1908.

(Elevation, 1135′ B.A.T.)	Thickness Feet.	Total Feet.
Conductor	16	16
Unrecorded	444	460
Coal, native, (Washington)	2	462
Unrecorded	412	874
Coal, Mapletown (Sewickley) and unrecorded	95	969
Pittsburgh coal	7	976
Unrecorded	362	1338
Little Dunkard sand	25	1363
Unrecorded	75	1438
Big Dunkard sand	42	1480
Unrecorded	244	1724
H Cow Run sand	21	1745

	Thickness. Feet.	Total. Feet.
Unrecorded	20	1765
First Salt sand	85	1850
Unrecorded	45	1895
Second Salt sand	10	1905
Unrecorded	182	2087
Maxton sand (gas, 2107'; heavy, 2117') and unrecorded	35	2122
Little Lime	13	2135
Pencil cave	10	2145
Big Lime	95	2240
Big Injun sand	170	2410
Unrecorded	8	2418
Squaw sand	4	2422
Unrecorded	468	2890
Fifty-foot sand	57	2947
Unrecorded	31	2978
Thirty-foot sand (gas, 2987'; oil, 2990'-2995')	22	3000
Unrecorded	5	3005
Sand	4	3009
Unrecorded	5	3014
Sand	11	3025
Unrecorded	10	3035
Sand and unrecorded	37	3072
Gordon Stray sand	33	3105
Unrecorded	3	3108
Gordon sand	19	3127
Unrecorded	25	3152
Fourth sand	26	3178
Unrecorded	31	3209
Fifth sand	10	3219
Unrecorded to bottom	21	3240

Original test 28/10 mercury in 5 3/16" opening for Maxton sand (equivalent to 6,200,000 cu. ft. daily).

Rock pressure, 630 lbs. in 60 minutes. Shot March 28, 1910, in "Thirty-foot" with 50 quarts, 4½" shell, top, 2895'.

John Glover No. 1 Well Record (351).

Located in Mannington district, 1.1 miles northwest of Glover Gap. Authority, Fisher Oil Company. Completed Oct. 22, 1910.

(Elevation, 1460'B-A.T.)	Thickness Feet.	Total Feet.
Unrecorded	1185	1185
Coal, Mapletown (Sewickley)	5	1190
Unrecorded	90	1280
Coal, Pittsburgh	10	1290
Unrecorded	1220	2510
Big Lime	75	2585
Big Injun sand	170	2755
Unrecorded	495	3250
Fifty-foot sand	25	3275
Unrecorded	26	3301
Thirty-foot (oil) sand to bottom	19	3320

Conductor, 16'; 10" casing, 416'; 8¼" casing, 1767'; 6-5/8" casing, 2695'.

Shot Dec. 29, 1910, with 20 quarts from 3312' to 3319'. Well filled up half full of oil one hour after shot.

A. M. Glover No. 3 Well Record (355).

Mannington district, 0.6 mile northwest of Glover Gap. Authority, Venture Oil Company. Commenced Feb. 24, 1910.

(Elevation, 1070'B-A.T.)	Thickness Feet.	Total Feet.
Unrecorded	450	450
Bluff sand	58	508
Waynesburg coal	4	512
Unrecorded	243	755
Mapletown (Sewickley) coal	5	760
Unrecorded	97	857
Pittsburgh coal	6	863
Unrecorded	1220	2083
Pencil cave	3	2086
Big Lime	77	2163
Big Injun sand	150	2313
Unrecorded	467	2780
Fifty-foot sand	67	2847
Unrecorded	37	2884
Thirty-foot sand (oil, 2890'-2900')	19	2903

10" casing, 310'; 8¼" casing, 1308'; 6⅝" casing, 2100'; 5 3/16" casing, 2416'.

The following is the record of a well in the northwest edge of this Thirty-foot sand oil pool that proved dry at the latter horizon, but gas was encountered in the Maxton, Big Injun, and Fifty-foot, and oil in the Gordon Stray and Gordon:

Dorcas (T. J.) Ash No. 3 Well Record (347).

Mannington district, 1.9 miles northwest of Glover Gap. Authority, South Penn Oil Company. Completed in 1909.

(Elevation, 1100'B-A.T.)	Thickness Feet.	Total Feet.
Conductor	16	16
Unrecorded	494	510
Bluff sand	30	540
Unrecorded	274	814
Coal, Mapletown (Sewickley)	3	817
Unrecorded	101	918
Pittsburgh coal (steel Line measurement)	7	925
Unrecorded	79	1004
Sand, (Minshall)	41	1045
Unrecorded	332	1377
Little Dunkard sand (steel line measurement)	50	1427
Unrecorded	218	1645
Gas and II Cow Run sand	204	1749
Unrecorded	59	1808
First Salt sand	72	1880
Unrecorded	25	1905
Second Salt sand and unrecorded	122	2027
Maxton sand (gas, 2035'; steel line measurement)	49	2076
Unrecorded	29	2105

	Thickness. Feet.	Total. Feet.
Pencil cave	5	2110
Big Lime	86	2196
Big Injun sand (gas show, 2206'; steel line measurement).	164	2360
Unrecorded	484	2844
Fifty-foot sand (gas, 2893'; steel line measurement)	60	2904
Unrecorded	29	2933
Thirty-foot sand	33	2966
Unrecorded	10	2976
Red rock	6	2982
Unrecorded	48	3030
Gordon Stray sand (oil show, 3042'; steel line measurement) and unrecorded	34	3064
Gordon sand (oil, 3066'; steel line measurement) to bottom Still in Gordon sand.	13	3077

10" casing, 156'; 8¼" casing, 1411'; 6⅝" casing, 2137'; 5 3/16" casing, 3067'.

Southwestward along the axis of the Robinson Basin from the Glover Gap Thirty-foot oil pool, dry holes were drilled on the Solomon Glover (356) and J. L. Hamilton (360) farms, located 1.6 miles southwest of Glover Gap and 1.3 miles northwest of Seven Pines, respectively.

Passing on southwestward along the axis of the same basin, another small oil pool consisting of about a dozen producers is found, on Warrior fork, 1 mile southwest of Seven Pines. The oil occurs in the Maxton and Gordon as shown by the log of the **Joseph Hayhurst No. 1 well (374)**, located at the mouth of Evans run, as published on page 173 of Vol. I(A) of the State Survey reports. The log of the **Rachel Evans** No. 1 dry hole (375), located 0.7 mile westward, is published on page 165 of the same report.

The following is the log of a Maxton oil well in the above mentioned pool:

Joseph Hayhurst No. 4 Well Record (373).

Mannington district, 1.1 miles northwest of Rymer. Authority, South Penn Oil Company. Completed May 19, 1909.

(Elevation, 1065'B-A.T.)	Thickness Feet.	Total Feet.
Conductor	15	15
Unrecorded	775	790
Mapletown (Sewickley) coal	..	790
Unrecorded	90	880
Pittsburgh coal (steel line measurement)	..	880
Unrecorded	480	1360
Big Dunkard sand	40	1400

	Thickness. Feet.	Total. Feet.
Unrecorded	149	1549
Gas sand	195	1744
Unrecorded	36	1780
Salt sand	123	1903
Unrecorded	29	1932
Sand	33	1965
Unrecorded	50	2015
Maxton sand (oil, 2046′ and 2062′)	54	2069
Unrecorded to bottom (steel line measurement)	2	2071

10″ casing, 287′; 8¼″ casing, 1360′; 6⅝″ casing, 1912′; hole reduced, 2022′.

The two following are very complete records from wells located one mile southward along the Robinson synclinal axis. The first had a show of oil in the Maxton and gas in the Stray: the second was a gasser in the Big Injun with a show of oil in the Fourth sand:

Riley Arnett No. 2 Well Record (371).

Mannington district, 1.7 miles S 85° W of Rymer. Authority, South Penn Oil Company.

(Elevation, 1120′ B-A.T.)	Thickness Feet.	Total Feet.
Conductor	16	16
Slate and shells	231	247
Slate	78	325
Limestone	55	380
Slate	70	450
Coal, (Washington)	4	454
Slate	71	525
Limestone	50	575
Sand	50	625
Slate	25	650
Limestone	60	710
Slate	15	725
Limestone	135	860
Coal, (Sewickley)	4	864
Limestone	88	952
Coal, Pittsburgh	5	957
Red rock, limestone, sand and slate in alternate layers, no coal	1074	2031
Red rock	45	2076
Sand, (Maxton) (oil show, 2115′-2119′)	57	2133
Shale	17	2150
Limestone (Big Lime)	75	2225
Big Injun sand	158	2383
Slate	69	2452
Limestone	76	2528
Slate	57	2585
Limestone	13	2598
Slate and shells	8	2606

	Thickness. Feet.	Total. Feet.
Limestone	124	2730
Sand	3	2733
Slate	41	2774
Limestone	46	2820
Sand, (Fifty-foot)	38	2858
Slate	10	2868
Sand	12	2880
Slate	26	2906
Limestone	19	2925
Red rock	16	2941
Sand, (Thirty-foot)	33	2974
Slate	13	2987
Sand, (Stray and Gordon) (gas, 3023')	118	3105
Slate	21	3126
Sand, (Fourth)	50	3176
Slate to bottom	44	3220

10" casing, 247'; 8¼" casing, 1385'; 6⅝" casing, 2274'.

Riley Arnett No. 1 Well Record (372).

Mannington district, 1.1 miles west of Rymer. Authority, South Penn Oil Company. Completed July 9, 1893.

(Elevation, 1055' B-A. T.)	Thickness Feet.	Total Feet.
Sand and red rock	250	250
Limestone	50	300
Slate	50	350
Coal, (Washington)	12	362
Slate and limestone	103	465
Sand	35	500
Coal, (Waynesburg)	5	505
Slate	20	525
Sand	15	540
Slate	95	635
Limestone	110	745
Slate	24	769
Mapletown (Sewickley) coal	5	774
Slate and limestone	98	872
Pittsburgh coal	13	885
Cave	20	905
Limestone	35	940
Slate	30	970
Sand (water) (Minshall)	50	1020
Lime, reds, slate and sand, with no coal	920	1940
Red rock	30	1970
Sand, (Maxton)	105	2075
Limestone (Big Lime) (cased 6⅝" at 2113')	73	2148
Sand, dark gray (gas show, 2174').36'.		
Sand, hard, white 6		
Sand and limestone.....40		
Sand, hard, white 10		
Sand, soft (gas show, 2234').....12		
Slate 3	**Big Injun sand..** 222	2370
Sand, hard, white 37		
Slate 39		
Limestone 30		
Sand 20		

	Thickness. Feet.	Total. Feet.
Limestone	50	2420
Slate	40	2460
Sand and limestone	50	2510
Slate and shells	140	2650
Limestone and slate	50	2700
Sand and shells	20	2720
Slate and shells	35	2755
Sand, (Gantz)	65	2820
Slate and sand shells	20	2840
Sand (Fifty-foot, Thirty-foot, Stray and Gordon)	192	3032
Slate	53	3085
Sand shells (Fourth) (oil show, 3086')	3	3088
Slate, dark	40	3128
Shell, dark	1	3129
Slate, dark	40	3169
Shell, dark	1	3170
Slate, dark	30	3200
Shell, dark	1	3201
Slate, dark	19	3220
Shell, dark	1	3221
Slate to bottom	76	3297

10" casing, 262'; 8¼" casing, 1057'; 6⅝" casing, 2113'.

One mile westward in the vicinity of Brink there occurs a small oil pool, consisting of about a dozen wells in the Big Injun sand. The following log is from this pool:

John Ott No. 1 Well Record (367).

Mannington district, 0.5 mile northeast of Brink. Authority South Penn Oil Company. Completed Dec. 27, 1898.

	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	891	907
Pittsburgh coal	8	915
Unrecorded	1213	2128
Big Lime	70	2198
Big Injun sand (gas, heavy flow, 2198'-2213'; first oil pay, 2303') and unrecorded to bottom	127	2325

"10" casing, 537'; 8¼' casing, 1427'; 6⅝" casing, 2176'; 5⅜" casing, 2230'; hole reduced to 4¾" at 2230'."

Slightly over a mile west of Curtisville a Gordon sand oil pool occurs, consisting of 35 to 40 producing wells that were drilled about 10 years ago. Situated as it is in the low point of the Robinson Basin, it conforms ideally to the anticlinal theory in its accumulation. The three following records are from wells in this pool:

W. N. Cunningham No. 4 Well Record (462).

Mannington district, 1.3 miles N 85° W of Curtisville. Authority, South Penn Oil Company. Completed July 8, 1902.

(Elevation, 1075′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	788	804
Mapletown (Sewickley) coal	5	809
Unrecorded	106	915
Pittsburgh coal	8	923
Unrecorded	1315	2238
Big Injun sand (water, hole full, 2315′)	122	2360
Unrecorded	610	2970
Gordon Stray sand	16	2986
Unrecorded	4	2990
Gordon sand (first oil pay, 3004′) and unrecorded to bottom	23	3013

10″ casing, 253′; 8¼″ casing, 1419′ 4″; 6⅝″ casing, 2339′ 9″. Shot with 20 quarts; 6′ shell, top, 3003′. Shot Aug. 7, 1905, with 37 quarts; 7′x4¼″ shell, top, 3003′.

Jacob Cunningham No. 9 Well Record (464).

Mannington district, 1.4 miles S 75° W of Curtisville. Authority, South Penn Oil Compeny. Completed Sept. 19, 1903.

(Elevation, 1070′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	784	800
Mapletown (Sewickley) coal	5	805
Unrecorded	90	895
Pittsburgh coal	7	902
Unrecorded	1214	2116
Big Lime	70	2186
Big Injun sand (water, 2305′)	124	2310
Unrecorded	478	2788
Fifty-foot sand	20	2808
Unrecorded	159	2967
Gordon Stray sand	13	2980
Unrecorded	12	2992
Gordon sand (first pay, 2995′; second, 3000′) and unrecorded to bottom	23	3015

"10″ casing, 264′; 8¼″ casing, 1409′; 6⅝″ casing, 2253′; 5 3/16″ casing, 2415′.

Shot Aug. 21, 1903, with 20 quarts; 4′ shell, top, 2996′.

First production, **20 barrels daily.**

Jacob Cunningham No. 3 Well Record (465).

Mannington district, 1.8 miles S 70° W of Curtisville. Authority, South Penn Oil Company. Completed March 24, 1902.

(Elevation, 1155′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	919	935

	Thickness. Feet.	Total. Feet.
Mapletown (Sewickley) coal	...	935
Unrecorded	100	1035
Pittsburgh coal	...	1035
Unrecorded	770	1805
Gas sand (water, 1890')	103	1908
Unrecorded	340	2248
Big Lime	80	2328
Big Injun sand (water, 2338' and 2413')	120	2448
Unrecorded	635	3083
Gordon Stray sand	29	3112
Unrecorded	5	3117
Gordon sand (first pay, 3127'; second, 3129') and unrecorded to bottom	21	3138

10" casing, 225'; 8¼" casing, 1463' 9"; 6⅝" casing, 2245' 5"; 5⅜" casing, 2450' 5"; 4½" x 4" casing, 179' (bottom at 3117').

Production first 24 hours, 37½ barrels. Shot with 16 quarts, 8' shell top at 3127'.

The log of the W. N. Cunningham No. 1 (463), located in this pool, 0.9 mile northward, is published on pages 173-174 of Vol. I(A) of the State Survey reports.

Campbell Run Oil Pool.—What is known as the Campbell Run oil pool consists of 80 to 100 producing oil wells included within the boundaries of Mannington district, extending southwest from the Monongalia-Marion county line on the waters of Campbell run and Pyle's fork to near the head of State Road fork. The producing sands therein are the Big Injun, Gordon and Fourth. The initial production of some of the Gordon sand wells was over 3000 barrels of oil daily, many making 1500 to 2000 barrels. The Big Injun and Fourth sand wells were not nearly so large but held up better. Considered structurally the pool lies down near the foot of the east slope of the Robinson syncline and is suddenly terminated to the southwest by a local anticlinal bulge, slightly over a mile southward from Glover Gap, along the crest of which fold there occur one-half dozen gas wells. Out of the large number drilled, the seven following records from wells in this field exhibit the rock succession, the depths of the several oil pays and other data of economic interest:

Isaac Campbell No. 5 Well Record (421).

Mannington district, 2.3 miles north of Metz. Authority, South Penn Oil Company. Completed to 3168', Feb. 8, 1899.

	Thickness. Feet.	Total. Feet.
Unrecorded	990	990
Pittsburgh coal	...	990
Unrecorded	1233	2223
Big Lime	67	2290
Big Injun sand (gas, 2310'; water, 2400')	160	2450
Unrecorded	435	2885
Gantz sand	15	2900
Unrecorded	40	2940
Fifty-foot sand	40	2980
Unrecorded	5	2985
Thirty-foot sand	20	3005
Unrecorded	133	3138
Stray sand	10	3148
Unrecorded	6	3154
Gordon sand (oil, 3154') and unrecorded	48	3202
Gordon sand	8	3210
Unrecorded	25	3235
Fourth sand (oil, 3240'; gas, 3244') and unrecorded to bottom	23	3258

The above well had an initial production of 800 bbls. of oil daily from the Gordon sand. Six years later it was drilled on down through the Fourth, making 10 bbls. daily from that horizon.

Isaac Campbell No. 2 Well Record (420).

Mannington district, 2.4 miles north of Metz. Authority, South Penn Oil Company. Completed Aug. 16. 1898.

	Thickness. Feet.	Total. Feet.
Unrecorded	1006	1006
Pittsburgh coal	9	1015
Unrecorded	1225	2240
Big Lime	60	2300
Big Injun sand (water, 2410')	170	2470
Unrecorded	686	3156
Gordon sand (oil, 3162', 3166') (Drilled deeper Sept. 19, 1907).	10	3166
Unrecorded	88	3254
Fourth sand (oil, 3258') and unrecorded to bottom	21	3275

The above well had an initial oil production of 200 bbls. daily. About 6 years later it was drilled on down through the Fourth, making an initial production of 30 bbls. daily from that sand and was still producing in August, 1911, 5 bbls. daily.

James Fox No. 1 Well Record (419).

Mannington district, 3 miles southwest of Mannington. Authority, South Penn Oil Company.

(Elevation, 1190′ B-A. T.)	Thickness. Feet.	Total. Feet
Conductor	10	10
Unrecorded	900	910
Mapletown (Sewickley) coal	5	915
Unrecorded	85	1000
Pittsburgh coal	8	1008
Unrecorded	1247	2255
Big Lime	90	2345
Big Injun sand (water, 2420′)	167	2512
Unrecorded	615	3127
Gordon Stray sand	15	3142
Break	3	3145
Gordon sand (first oil pay, 3169′; second, 3180′) and unrecorded to bottom	53	3198

10″ casing, 260′; 8¼″ casing, 1393′ 7″.

Eliz. Thomas No. 1 Well Record (416).

Mannington district, 2.1 miles northeast of Metz. Authority, South Penn Oil Company. Completed March 12, 1898.

(Elevation, 1086′ L-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	800	800
Coal, Mapletown (Sewickley)	5	805
Unrecorded	95	900
Pittsburgh coal	10	910
Unrecorded	1210	2120
Big Lime	55	2175
Sand, Big Injun	58	2233
Red sand	15	2248
Big Injun sand	87	2335
Unrecorded	720	3055
Gordon sand (oil, 3064′)	17	3072
Unrecorded	58	3130
Gordon sand	10	3140
Unrecorded	16	3156
Fourth sand and unrecorded to bottom	22	3178

10″ casing, 184′; 6⅝″ casing, 1883′; 5$\frac{3}{16}$″ casing, 2370′; 4½′x4″ casing, 256′.

No oil was reported in the Fourth sand.

The I. E. Arnett No. 1 well (415), located 0.2 mile southward, had an initial oil production of 300 bbls. daily from the Gordon.

Thos. P. Freeland No. 1 Well Record (403).

Mannington district, 1.1 miles northwest of Metz. Authority, South Penn Oil Company. Completed April 12, 1900.

(Elevation, 1015′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	739	755
Coal, Pittsburgh	7	762
Unrecorded	1308	2070
Big Injun sand (oil, 2170′) to bottom	114	2184

10″ casing, 212′; 8¼″ casing, 1258′; 6⅝″ casing, 2634′.
May 4th, shot with 16 quarts; 8′ shell; top of shot, 2169′.
March 20th, shot with 20 quarts; 7′8″ shell; top of shot, 2170′.

Snodgrass Bros. No. 3 Well Record (394).

Mannington district, 0.6 mile southeast of Glover Gap. Authority, Freehold Oil & Gas Company. Completed Aug. 13, 1907.

(Elevation, 1055′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	712	712
Mapletown (Sewickley) coal	...	712
Unrecorded	100	812
Pittsburgh coal	...	812
Unrecorded	1293	2105
Big Injun sand (3 bailers water, 2117′; little gas, 2152′; little gas and heavy water, 2209′)	641	2746
Gantz sand and unrecorded (little water, 2816′)	109	2855
Thirty-foot sand	25	2880
Unrecorded	30	2910
Sand and unrecorded	45	2955
Sand and unrecorded	23	2978
Campbell's Run (Gordon) sand (oil, 2982′) and unrecorded to bottom	24	3002

The small water pay at 2816 feet is unusual in formations below the Big Injun in this portion of the State.

Benj. Dodd No. 3 Well Record (389).

Mannington district, 0.8 mile S 5° E of Glover Gap. Authority, South Penn Oil Company. Completed April 19, 1894.

(Elevation, 1255′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded (water, 90′)	644	660
Bluff sand	15	675
Unrecorded	235	910
Coal, Mapletown (Sewickley)	4	914
Unrecorded	94	1008
Coal, Pittsburgh	12	1020
Unrecorded	660	1680
Gas sand (water and gas, 1790′)	140	1820
Unrecorded	105	1925

	Thickness. Feet.	Total. Feet.
Salt sand	120	2045
Unrecorded	180	2225
Pencil cave	15	2240
Big Lime	78	2318
Big Injun sand (salt water, 2322'; oil, 2418'; water, 2421') and unrecorded to bottom	130	2448

10" casing, 228'; 8¼" casing, 1490'; 6⅝" casing, 2080'; 5 3/16" casing, 2383'.

In addition to the brief records as given in the Marion county table of wells, the much more complete logs of the following from the Campbell Run oil pool are given on the pages indicated in Vol. I(A) of the State Survey reports:

No. on Map II.	Name of Well.	Location.	Page of Vol. I(A)
396	Lusetta Snodgrass No. 1	Metz, 1.6 miles N 50° W of.	166
398	Aaron Furbee No. 1	Metz, 1.5 miles N 40° W of.	165
402	Lemley & Hibbs No. 1	Metz, 1.3 miles N 40° W of.	164
408	Scott Arnett No. 1	Metz, 1.7 miles N 10° W of.	168
410	E. Moore Heirs No. 1	Metz, 2 miles N of	167
418	Simon Moore No. 1	Metz, 3 miles N of	167

No. 396 in above table was a Gordon sand oil producer. Had show of oil in Thirty-foot and heavy water in Big Injun.

No. 398 was a Gordon oil producer, with water and show of oil in Big Injun and Thirty-foot.

No. 402 was a Big Injun oil producer.

No. 408 was a Gordon sand oil producer with water in Big Injun.

No. 410 was drilled 15 years ago and had an initial oil production of 3200 bbls. daily, and was still making 3 bbls. daily in August, 1911.

No. 418 had a light show of oil in the Gordon sand. It was drilled on down through the Fourth sand, but no additional oil was encountered.

The **John Styles No. 1 well (409)**, located 2 miles N 10° W of Metz in the main valley of Campbell's run and drilled early in 1897 by the South Penn Oil Company, was the first Gordon oil well in this region. Thereafter the producing horizon was locally known as the "Campbell's Run" sand.

On the southwest slope of the anticlinal bulge south of Glover Gap, mentioned under the description of the Campbell Run oil pool, there are about a dozen Big Injun sand oil wells. The following is a record of one of these wells:

John Baker No. 4 Well Record (384).

Mannington district, 2.6 miles west of Metz. Authority, South Penn Oil Company.

	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	1140	1156
Mapletown (Sewickley) coal	4	1160
Unrecorded	96	1256
Pittsburgh coal	7	1263
Unrecorded	1230	2493
Big Lime	73	2566
Big Injun sand (oil, 2651′; water, 2655′) and unrecorded to bottom	109	2675

10″ casing, 556′; 8¼″ casing, 1760′; 6⅝″ casing, 2336′; 5 3/16″ liner, 2592′.

George Watson No. 1 Well Record (377).

Mannington district, 0.6 mile northeast of Seven Pines. Authority, South Penn Oil Co.

(Elevation, 1110′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Limestone and slate	434	450
Bluff sand	40	490
Limestone and slate	280	770
Mapletown (Sewickley) coal	2	772
Limestone	91	863
Pittsburgh coal	7	870
Slate	20	890
Limestone	100	990
Sand	40	1030
Red rock	100	1130
Sand, (Moundsville and I Cow Run)	185	1315
Slate	28	1343
Dunkard sand	82	1425
Slate	25	1450
Gas sand	275	1725
Slate	10	1735
Salt sand	90	1825
Slate	25	1850
Sand (water, 1940′)	90	1940
Slate	40	1980
Sand	30	2010
Slate and shell	80	2090
Pencil cave	3	2093
Big Lime	87	2180
Black sand	3	2183
Big Injun sand	122	2305
Slate and sand	465	2770
Fifty-foot sand	80	2850
Slate and shells	30	2880
Sand, (Thirty-foot)	40	2920
Shells	75	2995

	Thickness. Feet.	Total. Feet.
Sand, (Stray) (heavy gas, 2998')	20	3015
Slate	3	3018
Sand 12' / Slate 3 / Sand 15 } (Gordon) (show of black oil, 3033')	30	3048
Slate	2	3050
Sand	20	3070
Slate, black, to bottom	18	3088

10" casing, 156'; 8¼" casing, 1345'; 6⅝" casing, 1949'; 5 3/16" casing, 2320'.

Northwest of Logansport and northeastward from Rymer there occurs an oil pool in the Thirty-foot sand consisting of 50 to 60 wells. The five following records are from this region:

C. S. Pitzer No. 1 Well Record (446).

Mannington district, 1.3 miles N 80° E of Rymer. Authority, South Penn Oil Company. Completed Aug. 20, 1904.

(Elevation, 1320' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	869	885
Mapletown (Sewickley) coal	5	890
Unrecorded	92	982
Pittsburgh coal (steel line measurement)	8	990
Unrecorded	1222	2212
Big Lime	80	2292
Big Injun sand	140	2432
Unrecorded	448	2880
Fifty-foot sand	100	2980
Unrecorded	43	3023
Thirty-foot sand (oil, 3032')	26	3049
Unrecorded to bottom	3	3052

10" casing, 260'; 8¼" casing, 1477'; 6⅝" casing, 2137'; 5 3/16" casing, 2574'.

Shot Sept. 7, 1904, with 8 quarts; top, 3031'.
Shot Sept. 22, 1904, with 16 quarts; top, 3030'.
Shot Oct. 14, 1904, with 20 quarts; top, 3030'.
Shot Jan. 14, 1905, with 40 quarts; top, 3030'.
Shot May 15, 1905, with 60 quarts; top, 3030'.
Shot June 2, 1905, with 100 quarts; top, 3029'.
Shot Oct. 28, 1905, with 30 quarts; top, 3029'.
Shot Jan. 20, 1906, with 140 quarts; top, 3030'.

C. S. Pitzer No. 2 Well Record (444).

Mannington district, 1.3 miles northeast of Rymer. Authority, South Penn Oil Company. Completed Nov. 15, 1904.

(Elevation, 1450' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	5	5
Unrecorded	1015	1020
Pittsburgh coal (steel line measurement)	...	1020

	Thickness. Feet.	Total. Feet.
Unrecorded	1005	2025
Second Salt sand (water, 10 bailers, 2035'; 4 bailers, 2055').	60	2085
Unrecorded	280	2365
Big Lime	80	2445
Big Injun sand	145	2590
Unrecorded	470	3060
Fifty-foot sand (gas, 12/10 mercury; steel line measurement)	68	3128
Unrecorded	34	3162
Thirty-foot sand (oil, 3176') and unrecorded to bottom	25	3187

10" casing, 260'; 8¼" casing, 1608'5"; 6⅝" casing, 2120'6"; 5 3/16" casing, 2623'3".

Nov. 28, 1904, shot with 8 quarts; top, 3176'.
Dec. 8, 1904, shot with 12 quarts; top, 3175'.
Dec. 21, 1904, shot with 30 quarts; top, 3174'.
Jan. 2, 1905, shot with 40 quarts; top, 3176'.
Jan. 12, 1905, shot with 60 quarts; top, 3186'.
Feb. 15, 1905, shot with 50 quarts; top, 3187'.
Mar. 9, 1905, shot with 70 quarts; top, 3189'.
Apr. 4, 1905, shot with 90 quarts; top, 3176'.
May 1, 1905, shot with 100 quarts; top, 3176'.
June 20, 1905, shot with 120 quarts; top, 3176'.

J. L. Beatty No. 1 Well Record (447).

Mannington district, 1.2 miles north of Logansport. Authority South Penn Oil Company. Completed in 1897.

(Elevation, 1130' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Lime and slate	664	678
Mapletown (Sewickley) coal	5	683
Unrecorded	91	774
Pittsburgh coal	10	784
Slate and lime	16	800
Lime and sand	20	820
Slate and red rock	20	840
Unrecorded	100	940
Sand	20	960
Red rock and lime	210	1170
Sand	15	1185
Red rock	45	1230
Little Dunkard sand	30	1260
Lime	30	1290
Sand	110	1400
Sand and lime (water, 1560')	275	1675
Salt sand (gas, 1690')	175	1850
Lime and shells	175	2025
Big Lime	83	2108
Big Injun sand (water, 2188')	132	2240
Lime and sand	30	2270
Slate and lime	100	2370
Sand	70	2440
Lime	280	2720
Fifty-foot sand	60	2780

	Thickness. Feet.	Total. Feet.
Slate and lime	25	2805
Sand, (Thirty-foot) (gas, 2807'; oil, 2813'-2817'; steel line measurement)	35	2840
Red rock	10	2850
Lime	20	2870
Slate and shell	63	2933
Sand (Gordon) (white pebbles; gas, 2941')	30	2963
Slate and shell	10	2973
Gray sand (Gordon)	20	2993
Slate and shell	49	3042
Gray sand, (Fourth)	15	3057
Slate and shell to bottom	54	3111

10" casing, 148'; 8¼" casing, 1272'; 6⅝" casing, 2045'.
Shot Apr. 6, 1905, with 30 quarts; top, 2813'.
Shot June 9, 1905, with 50 quarts; top, 2813'.
Shot July 24, 1905, with 60 quarts; top, 2813'.
Shot Aug. 22, 1905, with 70 quarts; top, 2813'.
Shot Dec. 6, 1905, with 80 quarts; top, 2813'.

A. J. Hayes No. 8 Well Record (448).

Mannington district, 1.1 miles northeast of Rymer. Authority, Delmar Oil Company.

(Elevation, 1300' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	510	510
Coal, native (Washington)	10	520
Unrecorded	390	910
Coal, Mapletown (Sewickley)	7	917
Unrecorded	90	1007
Coal, Pittsburgh	9	1016
Unrecorded	191	1207
Murphy sand	20	1227
Unrecorded	180	1407
Little Dunkard sand	20	1427
Unrecorded	90	1517
Big Dunkard sand	30	1547
Unrecorded	160	1707
Gas sand	50	1757
Unrecorded	25	1782
Salt sand	298	2080
Unrecorded	77	2157
Maxton sand	30	2187
Unrecorded	33	2220
Little Lime	23	2243
Pencil cave	10	2253
Big Lime	90	2343
Big Injun sand	111	2454
Unrecorded	356	2810
Berea sand	45	2855
Unrecorded	75	2930
Fifty-foot sand	55	2985
Unrecorded	15	3000
Sand	15	3015

	Thickness. Feet.	Total. Feet.
Unrecorded	5	3020
Thirty-foot sand	4	3024
Unrecorded to bottom (oil, 3026')	13	3037

A. J. Hayes No. 13 Well Record (453).

Mannington district, 0.7 mile N 80° E of Rymer. Authority, Delmar Oil Company.

(Elevation, 1025' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	628	628
Coal, Mapletown (Sewickley)	5	633
Unrecorded	77	710
Pittsburgh coal	8	718
Unrecorded	1237	1955
Big Lime	85	2040
Big Injun sand	115	2155
Unrecorded	375	2530
Sand, (Berea)	50	2580
Unrecorded	70	2650
Gantz sand	10	2660
Unrecorded	10¼	2670
Fifty-foot sand	38	2708
Unrecorded	12	2720
Thirty-foot sand (oil, 2730')	21	2741
Unrecorded	17	2758
Gordon Stray sand	15	2773
Unrecorded	65	2838
Gordon sand (gas, 2853')	30	2868

The **Geo. Beatty No. 3 well (457)**, located 0.5 mile northeast of Logansport, made 1 to 1½ million cubic feet of gas daily from the Gordon sand, with a rock pressure of 650 lbs. to the square inch; and **No. 1 (458)** on the same farm had an initial oil production of 30 to 40 barrels daily from the Thirty-foot sand.

On the waters of Laurel run, immediately northwest of Curtisville, there occurs a small gas pool of one-half dozen wells. The following record from one of the wells shows that the Gordon and Fourth sands are the producing horizons:

Jonathan Arnett No. 1 Well Record (460).

Mannington district, 0.5 mile northwest of Curtisville. Authority, Carnegie Natural Gas Company. Completed August, 1908.

(Elevation, 1055' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	714	714
Coal, Mapletown (Sewickley)	...	714

	Thickness. Feet.	Total. Feet.
Unrecorded	104	818
Coal, Pittsburgh	...	818
Unrecorded	1327	2145
Big Injun sand	120	2265
Unrecorded	435	2700
Fifty-foot sand	55	2755
Unrecorded (hole reduced to 5 3/16" at 2900')	173	2928
Gordon sand (gas, 2931')	3	2931
Unrecorded	35	2966
Fourth sand (little gas, 2970')	30	2996
Unrecorded to bottom	2	2998

18" casing, 155'; 8¼" casing, 1270'; 6-5/8" casing, 2105'; 3" tubing, 2959'.

The following record of a well abandoned as non-paying, located 1.5 miles southward from the gas pool last mentioned, gives interesting data as to the coals of the Monongahela series as well as the horizons in which oil and gas shows were encountered:

Alexander Huey No. 1 Well Record (469).

Mannington district, 1.3 miles south of Curtisville. Authority, Delmar Oil Company.

	Thickness. Feet.	Total. Feet.
Unrecorded	161	161
Coal, native	5	166
Unrecorded	276	442
Coal, (Waynesburg)	11	453
Unrecorded	269	722
Coal, Mapletown (Sewickley)	8	730
Unrecorded	85	815
Pittsburgh coal (very broken)	6	821
Unrecorded	1212	2033
Maxton sand (oil, 2041')	10	2043
Unrecorded	139	2182
Big Injun sand	112	2294
Unrecorded	511	2805
Fifty-foot sand (gas, 2830')	50	2855
Unrecorded	5	2860
Thirty-foot sand (oil show, 2870')	36	2896
Unrecorded	19	2915
Gordon Stray sand	27	2942
Unrecorded	30	2972
Gordon sand (badly broken)	36	3008
Slaty shale to bottom	309	3317

Two miles southward from Logansport there occurs a small oil pool on the waters of Tucker fork and Coal Lick run. The three following records from wells therein, contain much data of interest and show the oil horizons to be the Maxton, Thirty-foot and Gordon sands:

M. W. Huey Heirs No. 1 Well Record (471).

Mannington district, 2.4 miles northwest of Pleasantville. Authority, South Penn Oil Company. Completed January 30, 1907.

(Elevation, 1320′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	844	860
Mapletown (Sewickley) coal	5	865
Unrecorded	90	955
Pittsburgh coal (steel line measurement)	10	965
Unrecorded	753	1718
Second gas sand (water, 1745′)	37	1755
Unrecorded	350	2105
Maxton sand	85	2190
Pencil cave	5	2195
Big Lime	79	2274
Big Injun sand (gas, 2345′; water, 2364′)	136	2410
Unrecorded	440	2850
Gantz sand	20	2870
Unrecorded	10	2880
Fifty-foot sand	35	3915
Unrecorded	35	2950
Thirty-foot sand (oil, 2960′) (steel line measurement)	28	2978
Unrecorded	123	3101
Gordon sand (oil, 3108′) and unrecorded to bottom	21	3122

10″ casing, 185′; 8¼″ casing, 1462′; 6⅝″ casing, 2236′; 5 3/16″ casing, 2412′.

J. A. Harbert No. 1 Well Record (472).

Mannington district, 2.4 miles northwest of Pleasantville. Authority, South Penn Oil Company. Completed June 26, 1909.

(Elevation, 1085′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	614	630
Mapletown (Sewickley) coal	4	634
Unrecorded	100	734
Pittsburgh coal	5	739
Unrecorded	851	1590
Sand (water, 1595′)	50	1640
Unrecorded	85	1725
Salt sand	70	1795
Unrecorded	90	1885
Maxton sand (oil, 1891′)	32	1917
Unrecorded to bottom	26½	1943½

10″ casing, 352′; 8¼″ casing, 1250′; 6⅝″ casing, 1659′8″.

Shot June 29, 1909, with 20 quarts; 5″ x 4′10″ shell; top, 1881′.

Shot June 30, 1909, with 20 quarts; 5″ x 4′10-7/8″ shell; top, 1891′.

George A. Huey No. 1 Well Record (472A).

Mannington district, 2.5 miles northwest of Pleasantville. Authority, South Penn Oil Company. Completed June 29, 1907.

(Elevation, 1350′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	854	870
Mapletown (Sewickley) coal	...	870
Unrecorded	102	972
Pittsburgh coal (steel line measurement)	5	977
Unrecorded	1183	2160
Maxton sand	85	2245
Big Lime (steel line measurement)	55	2300
Big Injun sand (water, 2382′)	120	2420
Unrecorded	487	2907
Fifty-foot sand	43	2950
Unrecorded	26	2976
Thirty-foot sand (oil show, 2991′) (steel line measurement)	20	2996
Unrecorded	98	3094
Gordon Stray sand (steel line measurement)	17	3111
Unrecorded	10	3121
Gordon sand (gas, 3126′; oil, 3130′) and unrecorded to bottom (steel line measurement)	25	3146

10″ casing, 193′; 8¼″ casing, 1504′; 6⅝″ casing, 2271′; 5 3/16″ casing, 2440′.

Shot June 27, 1907, with 30 quarts; 11′6″ x 4″ shell, top, 3129′.

The following is the record of a non-paying well drilled 1 mile southwestward from the last boring mentioned:

Daniel F. Heldreth No. 1 Well Record (474).

Mannington district, 2.1 miles northwest of Margaret. Authority, Chartiers Oil Company. Completed Feb. 5, 1910.

(Elevation, 1145′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	940	940
Pittsburgh coal	...	940
Unrecorded	1282	2222
Big Injun sand (little oil, and hole full of water, 2320′)	138	2360
Unrecorded	691	3051
Gordon sand (gas, 3053′; gas and oil show, 3076′)	38	3089
Slate and shells to bottom	653¼	3742¼

10″ casing, 163′; 8¼″ casing, 1361′; 6⅝″ casing, 2344′; 5 3/16″ casing, 2913′.

"After standing 4 days hole filled up 150 feet with oil."

In the extreme southwest corner of Mannington district, Marion county, there occurs a very rich oil pool on the waters of Quaker fork, consisting of about 60 wells, the Gordon Stray and Gordon sands being the producing horizons. The wells had an initial oil production ranging from 10 to 500 barrels

daily, the latter sand being the most prolific. The pool conforms ideally with the anticlinal theory of the accumulation of oil and gas, in that it lies down near the low point of the Robinson synclinal basin, since the Stray and Gordon sands are both non-water bearing in this portion of the State. The five following records of wells therein give much data of interest for this region:

A. J. Ice, Jr., No. 1 Well Record (486).

Mannington district, 2 miles N 80° W of Margaret. Authority, Delmar Oil Company.

(Elevation, 1135′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1020	1020
Pittsburgh coal	...	1020
Unrecorded	1230	2250
Big Lime	60	2310
Big Injun sand	105	2415
Unrecorded	661	3076
Gordon Stray sand (oil, 3079′)	15	3091
Unrecorded	14	3105
Gordon sand (oil, 3122′)	34	3139
Unrecorded to bottom	4	3143

"460 barrel well, best in field."

Joshua Looman No. 1 Well Record (482).

Mannington district, 2.1 miles northwest of Margaret. Authority, Delmar Oil Company.

	Thickness. Feet.	Total. Feet.
Unrecorded	1053	1053
Pittsburgh coal	10	1063
Unrecorded	1207	2270
Big Lime	56	2326
Big Injun sand (gas, 2350′; water, 2419′)	161	2487
Unrecorded	418	2905
Gantz sand	39	2944
Unrecorded	11	2955
Fifty-foot sand	93	3048
Unrecorded	82	3130
Gordon sand (oil, 3138′)	34	3164

B. F. Robinson No. 4 Well Record (483).

Mannington district, 1.5 miles north of Alliance. Authority, Delmar Oil Company.

	Thickness. Feet.	Total. Feet.
Unrecorded	1225	1225
Pittsburgh coal	6	1231

	Thickness. Feet.	Total. Feet.
Unrecorded	319	1550
Little Dunkard sand	15	1565
Unrecorded	135	1700
Big Dunkard sand	45	1745
Unrecorded	45	1790
Gas sand	95	1885
Unrecorded	65	1950
Salt sand	245	2195
Unrecorded	255	2450
Pencil cave	5	2455
Big Lime	46	2501
Big Injun sand	154	2655
Unrecorded	67	2722
Squaw sand	40	2762
Unrecorded	327	3089
Gantz and Fifty-foot sand (oil and gas, 3094'; salt water, 3127')	102	3191
Unrecorded	9	3200
Thirty-foot sand	20	3220
Unrecorded	5	3225
Stray sand	53	3278
Unrecorded	2	3280
Stray sand	18	3298
Unrecorded	13	3311
Gordon sand	27	3338
Unrecorded to bottom	37	3375

The above well was apparently dry in both the Stray and Gordon sands, but had oil and gas in the Gantz. The pay of salt water in the Fifty-foot is unusual in the three counties.

Mary E. Price No. 1 Well Record (484).

Mannington district, 1.5 miles N 25° W of Alliance. Authority, Delmar Oil Company.

(Elevation, 1200' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1105	1105
Pittsburgh coal	6	1111
Unrecorded	1284	2395
Big Injun sand	85	2480
Unrecorded	674	3154
Gordon Stray sand (oil and gas, 3160')	26	3180
Unrecorded	6	3186
Gordon sand and unrecorded to bottom	24	3210

Jesse Talkington No. 1 Well Record (475).

Mannington district, 1.5 miles northwest of Margaret. Authority, Delmar Oil Company. Commenced March 8, 1900.

(Elevation, 1085' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	823	823
Pittsburgh coal	9	832

	Thickness. Feet.	Total. Feet.
Unrecorded	1205	2037
Dunkard sand and unrecorded	189	1410
Gas sand	100	1510
Unrecorded	70	1580
Salt sand	314	1894
Unrecorded	143	2037
Big Lime	70	2107
Big Injun sand	130	2237
Unrecorded	478	2715
Gantz and Fifty-foot sand (gas, 2747')	99	2814
Unrecorded	124	2938
Gordon sand (oil and gas, 2953')	32	2970
Shells to bottom	354	3324

"Five feet of good loose sand in Gordon."

10" casing, 179'; 8¼" casing, 1237'; 6⅝" casing, 2128'; 5 3/16" casing, 2270', on wall packer.

The following is the record of the well mentioned on page 390 under the description of the Moundsville sand, in which the gas pay evidently occurs in the latter formation. The boring stopped 300 to 400 feet above the top of the Big Injun sand:

A. H. Heldreth No. 1 Well Record (478).

Mannington district, 0.5 mile northwest of Margaret. Authority, Delmar Oil Company.

(Elevation, 1050' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	660	660
Pittsburgh coal	9	669
Unrecorded	321	990
Sand, Little Dunkard? (Moundsville) (gas, 1000')	28	1018
Unrecorded	62	1080
Big Dunkard sand	55	1145
Unrecorded	155	1300
Gas sand	25	1325
Unrecorded	205	1530
Salt sand	30	1560
Unrecorded to bottom	47	1607

Flat Run Oil Pool.—What is known as the Flat Run oil pool is that belt of wells extending southwestward along the waters of Flat run and Pyle's fork to the north edge of Mannington, the whole containing about 125 producing wells, the initial production of which ranged from 5 to over 3000 barrels daily from the Fourth and Big Injun sands. The **J. A. Thomas No. 1 well (429)**, located 0.2 mile north of Condit on Flat run and completed in 1894 by the South Penn Oil Company, was the first well drilled in this pool in searching for its exten-

sion northward from Mannington. The detailed record of this well is published on pages 245-246 of Vol. I of the State Survey reports. The oil pay occurs in the Fourth sand, the top of which comes 2227 feet below the Pittsburgh coal. This well has produced an enormous amount of oil, since it started off at 3100 barrels daily in 1894 and was still making 3 to 4 barrels daily in August, 1911.

In addition to the brief logs of the list of wells below from the Flat Run oil pool the more complete records of the same are given on the pages indicated of Vol. I(A) of the State Survey reports, to which the reader is referred for coal data and general information concerning the rock succession.

No. on Map II.	Name of Well.	Location.	Page of Vol. I(A)
426	Sanford Toothman No. 1	Galletin, 1.4 miles SW of	170
427	W. R. Dickens No. 1...	Condit, 1.5 miles NE of.	171
428	Mike Snyder No. 2.....	Condit, 0.4 mile N of....	172
432	E. J. Freeland No. 1....	Condit, 0.5 mile W of...	166
493	Nimrod Morgan No. 7...	Mannington, 0.9 mile N of	163
494	Nimrod Morgan No. 5...	Mannington, 0.8 mile N of	163
495	Paddy Hopkins No. 2...	Mannington, 0.7 mile N of	159
496	Paddy Hopkins No. 1...	Mannington, 0.6 mile N of	159

No. 426 above was a Fourth sand oil producer with oil show in the Big Injun and Gantz sands.

No. 427 was a 15-barrel oil producer from the Fourth sand, with a show of oil in the Big Injun.

No. 428 was an oil producer from the Big Injun and Fourth.

No. 432 was an oil producer from the Big Injun and Fifth, with a gas pay in the Fifty-foot.

No. 493 was a Fourth sand oil well with a Big Injun gas pay.

No. 494 was a Fourth sand oil well.

No. 495 was a Fourth sand oil well.

No. 496 was a Fourth sand oil well with gas in Gantz and Fifty-foot.

The eight following records are from wells scattered throughout the Flat Run oil belt from Galletin southwestward to Drake's run of Pyle's fork:

John W. Grubb No. 2 Well Record (425).

Mannington district, 0.9 mile southwest of Galletin. Authority, South Penn Oil Company. Completed June 19, 1897.

(Elevation, 1109' L-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	800	800
Pittsburgh coal	...	800

	Thickness. Feet.	Total. Feet.
Unrecorded	900	1700
Salt sand (water, 1840')	140	1840
Unrecorded	160	2000
Big Lime (cave, 2030')	70	2070
Big Injun sand	140	2210
Sand, hard, Big Injun (oil, gas and water, 2190')	70	2280
Unrecorded	716	2996
Fourth sand (oil pay, 2996')	32	3028
Unrecorded to bottom	2	3030

Mike Snyder No. 2 Well Record (428).

Mannington district, 0.5 mile north of Condit. Authority, South Penn Oil Company. Completed Sept. 13, 1895.

(Elevation, 1174' L-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	18	18
Unrecorded	792	810
Pittsburgh coal	...	810
Unrecorded	533	1343
Dunkard sand	70	1413
Unrecorded	62	1475
Gas sand	65	1540
Unrecorded	270	1810
Salt sand	110	1920
Unrecorded	90	2010
Pencil cave	6	2016
Big Lime	121	2137
Big Injun sand (oil, 2211')	133	2270
Unrecorded	440	2710
Gantz sand	45	2755
Unrecorded	15	2770
Fifty-foot sand	35	2805
Unrecorded	20	2825
Thirty-foot sand and unrecorded	145	2970
Sand, (Gordon)	55	3025
Unrecorded	7½	3032½
Sand, (Fourth) (oil, 3044' and 3060') and unrecorded to bottom	31½	3064

10" casing, 330'; 8¼" casing, 1362'; 6⅝" casing, 2116'; 5 3/16" casing, 2261'; 4¼"x4" casing, 774'.

Shot June 28, 1900, with 30 quarts; 15' shell, top, 3045'.

Shot Oct. 31, 1900, with 30 quarts; 15' shell, top, 3044'.

Isaac F. Thomas No. 1 Well Record (423).

Mannington district, 1.5 miles southwest of Galletin. Authority, South Penn Oil Company. Completed about 17 years ago.

(Elevation, 1075' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	320	320
Bluff sand and unrecorded	380	700
Coal, Mapletown (Sewickley)	...	700
Unrecorded	90	790

	Thickness. Feet.	Total. Feet.
Coal, Pittsburgh	...	790
Unrecorded	1276	2066
Big Injun sand (gas, 2110'; oil show, 2183'; water, 2190')	189	2255
Unrecorded	475	2730
Fifty-foot sand	90	2820
Red rock and shell	155	2975
Gordon sand	15	2990
Unrecorded	15	3005
Gordon sand	7	3012
Shales	38	3050
Sand, hard, (Fourth)	12	3062
Slate and shell to bottom	134	3196

10" casing, 460'; 8¼" casing, 1340'; 6⅝" casing, 2040'; 5⅜" casing, 2185'.

The above was considered a dry hole and is located northwest down the structural slope 0.5 mile from the west edge of the Flat run oil belt.

Ash Fluharty No. 1 Well Record (431).

Mannington district at Condit. Authority, South Penn Oil Company. Completed Feb. 7, 1903.

(Elevation, 1000' L-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	506	506
Coal, Mapletown (Sewickley)	...	506
Unrecorded	101	607
Coal, Pittsburgh	...	607
Unrecorded	1260	1867
Pencil cave	5	1872
Big Lime	61	1933
Big Injun sand (oil, 2031') and unrecorded to bottom	121	2054

The above well had an initial oil production of 60 bbls. daily from the Big Injun, and was making 6 bbls. weekly in August, 1911.

C. W. Bayles No. 1 Well Record (433).

Mannington district, 1.2 miles southeast of Metz. Authority, South Penn Oil Company. Completed July 22, 1894.

(Elevation, 1000' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	17	17
Unrecorded	600	617
Pittsburgh coal	10	627
Unrecorded	510	1137
Dunkard sand and unrecorded	793	1930
Big Injun sand (oil and gas show, 2040')	120	2050

	Thickness. Feet.	Total. Feet.
Unrecorded	450	2500
Gantz sand	70	2570
Slate	10	2580
Fifty-foot sand (gas, 2580')	20	2600
Unrecorded	107	2707
Sand, (Stray)	30	2737
Slate	12	2749
Unrecorded	30	2779
Sand, (Gordon)	34	2813
Slate	2	2815
Sand, (Fourth) (oil, 2831')	27	2842
Unrecorded	3	2845
Hard sand (Fourth)	19	2864
Soft sand (Fourth)	10	2874
Slate	8	2882
Hard white sand (Fourth)	8	2890
Slate and shells to bottom	9	2899

10" casing, 248'; 8¼" casing, 1137'; 6⅝" casing, 1736'; 5 3/16" casing, 380'; 4¼"x4" casing, 769'9".

Shot Aug. 6, 1894, with 1½ quarts; Jan. 21, 1895, with 4 quarts; and Sept. 21, 1903. with 16 quarts.

Frank O. Price No. 1 Well Record (437).

Mannington district, 1.4 miles S 10° E of Metz. Authority, South Penn Oil Company. Completed June 1, 1898.

(Elevation, 1050' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	545	561
Coal, Mapletown (Sewickley)	...	561
Unrecorded	100	661
Coal, Pittsburgh	...	661
Unrecorded	1339	2000
Big Injun sand	120	2120
Unrecorded	480	2600
Gantz sand	15	2615
Unrecorded	5	2620
Fifty-foot sand	40	2660
Unrecorded	175	2835
Gordon Stray sand	23	2858
Unrecorded	7	2865
Gordon sand	23	2888
Unrecorded	12	2900
Fourth sand (oil, 2908')	24	2924
Unrecorded to bottom	5	2929

10" casing, 185'; 8¼" casing, 1250'; 6⅝" casing. 1678'; 5 3/16" casing, 2167'; 4¼" casing, 742'. Bottom liner, 2865'.

Shot Sept. 10, 1907, with 15 quarts; shell; top, 2907'.

Shot Jan. 2, 1902, with 20 quarts; 10' shell; top, 2907'.

Shot Feb. 26, 1902 (?) with 20 quarts; 10' shell; top, 2907'.

George Furbee No. 1 Well Record (497).

Mannington district, 0.5 mile northwest of Mannington. Authority, Marsh Oil & Gas Company. Completed in 1911.

(Elevation, 968' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	60	60
Waynesburg coal	4	64
Unrecorded	377	441
Pittsburgh coal	11	452
Unrecorded	431	883
Little Dunkard sand	30	913
Unrecorded	93	1006
Big Dunkard sand	94	1100
Coal, anthracite? (Lower Freeport)	3	1103
Unrecorded	23	1126
Gas sand	128	1254
Unrecorded	93	1347
Salt sand (hole full of water, 1363')	129	1476
Unrecorded	219	1695
Little Lime	15	1710
Pencil cave	5	1715
Big Lime	40	1755
Big Injun sand (gas, 1775'-1780'; oil show, 1865'-1871')	135	1890
Unrecorded	130	2020
Sand, (Squaw) (gas, 2024')	4	2024
Unrecorded	346	2370
Fifty-foot sand and unrecorded to bottom	..	....

(Still drilling).

The above well starts 3 feet below the Waynesburg "A" coal according to Reger.

Along the northeastern edge of Mannington district there occurs a small oil pool of four wells on the head of Llewellyn run, the following record of one of which shows the producing horizon to be the Big Injun sand. A gas pay was encountered in the Big Lime:

Daniel Varner No. 1 Well Record (487).

Mannington district, 1.8 miles N., 80° E. of Condit. Authority, Burt Oil Company. Commenced July 15, 1898.

(Elevation, 1155' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	594	610
Mapletown (Sewickley) coal	...	610
Unrecorded	100	710
Pittsburgh coal	..	710
Unrecorded	580	1290
Dunkard sand and unrecorded to bottom	880	2170

10" casing, 185'; 8¼" casing, 1290'; 6⅝" casing, 1590'; 5$\frac{3}{16}$" casing, 492' for liner 25 feet in Big Injun sand. Got oil at 2100 ft. cable measurement—steel line, 2123 ft. Big flow of gas 80 to 90 ft. above oil where the Big Lime should have been."

Southward on the same run and across on the head of Mahan run there are 8 or 10 gas wells in the Fifty-foot, Gantz and Fourth sands as shown by the five following records from wells in this region:

Columbus Snodgrass No. 1 Well Record (489).

Mannington district, 1.4 miles east of Condit. Authority, Burt Oil Company.

(Elevation, 1060' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	210	210
Bluff sand	20	230
Unrecorded	280	510
Mapletown (Sewickley) coal	5	515
Unrecorded	93	608
Pittsburgh coal	9	617
Unrecorded	343	960
Sand, (Moundsville)	40	1000
Unrecorded	76	1076
Big Dunkard sand	117	1193
Unrecorded	79	1272
First gas sand	88	1360
Unrecorded	10	1370
Second gas sand	97	1467
Unrecorded	66	1533
Salt sand	57	1590
Unrecorded	30	1620
Maxton sand	50	1670
Unrecorded	191	1861
Pencil cave	5	1866
Big Lime	55	1921
Big Injun sand	152	2073
Unrecorded	474	2547
Fifty-foot sand	58	2605
Unrecorded	195	2800
Gordon sand	37	2837
Unrecorded	6	2843
Gordon sand	10	2853
Unrecorded	4	2857
Fourth sand	49	2906
Unrecorded to bottom	31	2937

Thornton Fluharty No. 1 Well Record (490).

Mannington district, 1.1 mile southeast of Condit. Authority, Burt Oil Company.

(Elevation, 1055' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	150	150
Bluff sand	35	185
Unrecorded	290	475
Mapletown (Sewickley) coal	...	475
Unrecorded	100	575

	Thickness. Feet.	Total. Feet.
Pittsburgh coal	5	580
Unrecorded	1251	1831
Big Lime	83	1914
Big Injun sand	65	1979
Unrecorded	496	2475
Fifty-foot sand (gas, 2480′)	52	2527
Unrecorded	139	2766
Gordon Stray sand	21	2787
Unrecorded	9	2796
Gordon sand	11	2807
Unrecorded	18	2825
Fourth sand	44	2869
Unrecorded to bottom	166	3035

E. Wilson No. 1 Well Record (499).

Mannington district, 2.4 miles N 30° E of Mannington. Authority, South Penn Oil Company. Completed March 26, 1904.

(Elevation, 1180′ B.A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	579	595
Coal, Mapletown (Sewickley)	...	595
Unrecorded	101	696
Pittsburgh coal (steel line measurement)	6	702
Unrecorded	1273	1975
Big Lime	65	2040
Big Injun sand	129	2169
Unrecorded	451	2620
Sand, (Gantz) (gas, 2629′)	18	2638
Unrecorded	264	2902
Gordon Stray sand	10	2912
Unrecorded	12	2924
Sand, (Fourth) (gas, 2930′)	14	2938
Unrecorded	20	2958
Fourth sand (gas, 2961′) and unrecorded to bottom	15	2973

10″ casing, 226′; 8¼″ casing, 1229′; 6⅝″ casing, 1690′; 5 3/16″ casing, 2029′.

C. A. Kuhn No. 1 Well Record (500).

Mannington district, 2.3 miles N., 30° E. of Mannington. Authority, South Penn Oil Company. Completed Nov. 26, 1903.

(Elevation, 1195′ B-A. T.)	Thickness. Feet.	Total Feet
Conductor	16	16
Unrecorded	680	696
Pittsburgh coal	..	696
Unrecorded	1264	1960
Big Lime	57	2017
Big Injun sand	154	2171
Unrecorded	457	2628
Fifty-foot sand	55	2683
Unrecorded	235	2918

	Thickness. Feet.	Total. Feet.
Gordon sand	22	2940
Unrecorded	12	2952
Fourth sand (gas, 2954′)	62	3014
Unrecorded	100	3114
Sand, (Bayard)	2	3116
Unrecorded to bottom	16	3132

10″ casing, 219′; 8″ casing, 1218′; 6½″ casing, 1997′.

Ozias Kuhn No. 1 Well Record (501).

Mannington district, 2 miles N 30° E of Mannington. Authority, South Penn Oil Company. Completed March 5, 1895.

	Thickness. Feet.	Total. Feet.
Unrecorded	585	585
Coal, Mapletown (Sewickley)	...	585
Unrecorded	83	668
Pittsburgh coal	7	675
Unrecorded	1230	1905
Big Lime	75	1980
Big Injun sand (gas, 1987′)	110	2090
Unrecorded	470	2560
Gantz sand and unrecorded	70	2630
Fifty-foot sand (gas, 2640′) and unrecorded	236	2896
Sand, (Fourth) (gas, 2910′-2915′) to bottom	28	2924

13½″ casing, 41′; 10″ casing, 197′; 8¼″ casing, 1216′; 6⅝″ casing, 1727′; 5⅜″ casing, 2668′; 4½″ x 4″ casing,, 300′ (bottom at 2896′).

Shot Jan. 28, 1901, with 15 quarts; 10′ shell, top 2030′.

The following record of an isolated oil well on the head of Mahan run shows that the producing horizon is the Big Injun sand:

James Fluharty No. 1 Well Record (498).

Mannington district, 2.4 miles N 25° E of Mannington. Authority, South Penn Oil Company. Completed January 5, 1903.

(Elevation, 1305′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	698	714
Mapletown (Sewickley) coal	...	714
Unrecorded	104	818
Pittsburgh coal	...	818
Unrecorded	752	1670
Salt sand (water, 1755′)	203	1873
Unrecorded	207	2080
Pencil cave	5	2085
Big Lime	70	2155
Big Injun sand (first oil pay, 2239′) and unrecorded to bottom	99	2254

10″ casing, 230′; 8¼″ casing, 1322′11″; 6⅝″ casing, 2104′10″.

The Mannington Oil Pool.—The great Mannington oil pool belongs on a structural terrace on the western slope of the Wolf Summit anticline as shown by the wide divergence of the 500 and the 650-foot contours of the Pittsburgh coal bed southwestward from the Pawpaw-Lincoln district line. The Flat Run and the Mt. Morris-Fairview oil belts are separated by a width of 2 to 3 miles at the Monongalia-Marion county line, but southwestward they converge into one unbroken belt of wells from one mile north of Mannington to a point 4½ miles southwest of the latter place. The pool has a width of 4 miles westward from Downs, but tapers down to a width of one-half mile at its southwestern terminus, 1.3 miles north of Pleasantville. The main producing sands therein are the Big Injun, Gordon and Fourth. Within the boundaries of Mannington district 275 to 300 wells have been drilled in this oil belt southwest from the Lincoln-Mannington district line, 90 to 95 per cent of which were oil producers. The sudden termination of the pool to the southwest on the waters of Coal Lick run may be indirectly due to several causes combined, but the gradual disappearance in this direction of the structural terrace referred to above as revealed on Map II by the convergence of the 500 and the 650-foot contours of the Pitsburgh coal bed in the region of Pleasantville, resulting in the steepening of the structural slope in the Pleasantville region, has no doubt been an important contributing element. The initial oil production of the wells ranged from 5 to over 3600 barrels daily.

As mentioned on a preceding page, the **Fleming Hamilton No. 1 well (541)**, located on the waters of Flaggy Meadow, 0.5 mile south of Mannington and completed Oct 11, 1889, was the first well drilled in the Mannington field, a copious showing of oil therein being encountered in the Big Injun sand. The 11 following records from wells in this field, scattered from Mannington southwestward to near Pleasantville (Joetown), give interesting data as to the oil and gas horizons and the minable coals:

B. F. Blackshere No. 15 Well Record (502).

Mannington district, 0.6 mile northwest of Downs. Authority, South Penn Oil Company.

(Elevation, 1250′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	516	530
Mapletown (Sewickley) coal	..	530
Unrecorded	102	632
Pittsburgh coal	7	639
Unrecorded	911	1550
Salt sand (water, 1570′)	90	1640
Unrecorded	267	1907
Pencil cave	5	1912
Big Lime	78	1990
Big Injun sand (gas, 1998′; oil, 2100′) to bottom	135	2125

10″ casing, 327′.

F. H. Burt No. 15 Well Record (505).

Mannington district, at Mannington. Authority, Burt Oil Company. Completed January, 1892.

(Elevation, 1000′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	445	445
Pittsburgh coal	..	445
Unrecorded	1343	1788
Big Injun sand (first oil pay, 1858′; second, 1865′-1867′) and unrecorded	93	1881
Black slate to bottom	15	1896

10″ casing, 1151′; 7⅝″ casing, 473′; 6¼″ casing, 980′; 4⅞″ casing, 1717′6″.

Shot in 1892 with 8 quarts.

Shot in 1895 with 10 quarts in each pay.

F. H. Burt No. 14 Well Record (508).

Mannington district at Mannington. Authority, Burt Oil Company.

(Elevation, 1057′ L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	510	510
Pittsburgh coal	..	510
Unrecorded	1328	1838
Big Injun sand (first oil pay, 1914′; second, 1924′)	101½	1939½
Unrecorded	783½	2723
Fourth sand (oil pay, 2728′)	19	2742
Slate, dark, soft	20	2762
Fourth sand	16	2788
Dark slate to bottom	212	3000

10″ casing, 255′; 7⅝″ casing, 1030′; 5⅝″ casing, 1782′.

G. M. Floyd No. 1 Well Record (512).

Mannington district, 1.5 miles S 75° W of Mannington. Authority, South Penn Oil Company. Completed July 17, 1894.

(Elevation, 1000′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	18	18
Unrecorded	479	497
Pittsburgh coal	...	497
Unrecorded	530	1027
Dunkard sand	40	1067
Unrecorded	283	1350
Salt sand (water, 1380′)	125	1475
Unrecorded	370	1845
Big Injun sand	140	1985
Unrecorded	455	2440
Fifty-foot sand (gas, 2450′)	50	2490
Unrecorded	185	2675
Gordon Stray sand and unrecorded	30	2705
Fourth sand (first oil pay, 2709′; second pay, 2715′) to bottom	35	2740

10″ casing, 230′; 8¼″ casing, 1035′9″; 6⅝″ casing, 1519′; 5⅜″ casing, 1975′10″; 4½ x 4″ casing, 771′.

Shot Dec. 27, 1894, with 12 quarts; 8′ shell, top, 2709′.
Shot June 7, 1895, with 24 quarts; 12′ shell, top, 2709′.
Shot June 21, 1899, with 24 quarts; 25′ anchor.
Shot July 10, 1899, with 50 quarts; short shells, top, 2708′.

The above well starts 32 feet by hand-level below the Washington coal, according to Mr. Reger.

The R. P. Floyd No. 1 well (513), located 2 miles southwest of Mannington, drilled by the U. S. Oil Company and now owned by the South Penn Oil Compnay, was the largest producer in this pool

J. W. Conaway No. 3 Well Record (515).

Mannington district, 2.2 miles southwest of Mannington. Authority, South Penn Oil Company. Completed January 9, 1894.

(Elevation, 1064′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	124	140
Bluff sand	70	210
Unrecorded	262	472
Coal, Mapletown (Redstone)	4	476
Unrecorded	32	508
Pittsburgh coal	6	514
Unrecorded	541	1055
Dunkard sand	65	1120
Unrecorded	715	1835
Big Injun sand	30	1965

Unrecorded	465	2430
Gantz and Fifty-foot sands (gas, 2460′)	105	2535
Unrecorded	175	2710
Fourth sand (first pay, 2710′; increased to total depth to bottom	5	2715

10″ casing, 213′; 8¼″ casing, 1063′.. 6⅝″ casing, 1450′; 5 3/16″ casing, 2107′5″; 4¼″x4″ liner, 631′; bottom at 2710′.

"Shot March 19, 1902, with 24 quarts; 12′ shell, top, 2709′.

"Shot July 8, 1902, with 30 quarts; 5′ shell, top, 2709′.

The above well starts 16 feet by hand-level below the Washington coal, according to Reger.

The **Michael Kennedy No. 1 well (516)**, located on the head of Whetstone run, the log of which is published in connection with the Whetstone Run Section, page 127, had an initial oil production of over 1000 bbls. daily from the Fourth sand.

Martha B. Shafer No. 2 Well Record (525).

Mannington district, 2.3 miles northeast of Pleasantville. Authority, Chartiers Oil Company.

(Elevation, 1275′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	737	737
Pittsburgh coal	..	737
Unrecorded	1298	2935
Fourth sand (oil, 2943′-2955′) to bottom	20	2955

Not through sand.

10″ casing, 420′; 8¼″ casing, 1288′; 6⅝″ casing, 2208′; 5 3/16″ casing, 676′.

William Wright No. 1 Well Record (527).

Mannington district, 2 miles N., 20° E. of Pleasantville. Authority, South Penn Oil Company.

(Elevation, 1270′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	740	740
Pittsburgh coal	8	748
Unrecorded	982	1730
Salt sand	55	1785
Unrecorded (no Dunkard sand)	205	1990
Big Lime	64	2054
Big Injun sand (no oil or water)	121	2175
Unrecorded	550	2725
Fifty-foot sand (gas, 2730′)	50	2775
Unrecorded	115	2890
Stray sand	18	2908
Slate	2	2910
Fourth sand (oil) to bottom	28	2938

The above well, having an initial oil production of 3600 bbls. daily from the Fourth sand, was among the largest struck in the field.

P. Gaughan No. 1 Well Record (530).

Mannington district, 1.5 miles north of Pleasantville, about one mile west from Morgan gas well and about four miles south from Mannington, Marion county. Authority, South Penn Oil Company.

	Thickness. Feet.	Total. Feet.
Unrecorded	584	584
Pittsburgh coal	8	592
Unrecorded	1228	1820
Big Lime	80	1900
Big Injun sand (gas, 1950'; oil and water, 1998'; oil, 2009')	150	2050
Unrecorded (gas, 2494')	444	2494
Gantz sand	15	2509
Slate	15	2524
Gantz sand	24	2548
Slate	16	2564
Fifty-foot sand	31	2595
Red rock	30	2625
Thirty-foot sand (gas, 2654')	29	2654
Shells and slate (no good sand)	203	2857

E. C. Morgan No. 1 Well Record (534).

Mannington district, 1.5 miles northeast of Pleasantville. Authority, South Penn Oil Company. Completed in 1893.

(Elevation, 1455' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	868	882
Pittsburgh coal	8	890
Unrecorded (no Dunkard sand: salt water, 1680')	1264	2154
Big Lime	60	2214
Big Injun sand (salt water and oil, 2340')	131	2345
Unrecorded	425	2770
Gantz sand	60	2830
Slate	70	2900
Red rock	20	2920
Thirty-foot sand	50	2970
Slate	20	2990
Stray sand	55	3045
Slate	7	3052
Gordon sand (strong gas, 3055')		

10" casing, 505'; 8¼" casing, 1276'; 6⅝" casing, 2192'; 5⅜" casing, 2635'.

The above well is reported to have been the **greatest gasser** ever encountered in the State, and is the famous Morgan well mentioned by I. C. White on pages 69-70 of Vol. I(A) of the State Survey Reports, where the following is given:

" * * * * * so great was its pressure, that the drilling tools weighing several thousand pounds, were lifted from the bottom of the

well, and blown above the top of the derrick more than 100 feet into the air through 6⅝" casing, according to Mr. Worthington. The well defied all the usual methods of procedure in shutting in large gas wells, and only after three months of uninterrupted work was it finally conquered by the ingenuity of Messrs. Edwards and Worthington, and the men whom they directed. The 3-inch tubing could not be inserted in the 6⅝" in the customary manner, but required the pull of 'block and tackle' to force it into the well. Then when the proper depth (2270 feet) had been reached, where it was decided to set the rubber packer, it would not 'take hold,' and on withdrawing the tubing no rubber was visible, the fine sand and pebbles having been blown by the gas against it with such force as to destroy the rubber entirely and blow its material out as dust. This occurred several times until Messrs. Edwards and Worthington decided to wrap the 'packer' with iron wire before inserting the same, which finally proved successful and the well was shut in. This is the well which gave a pressure of 800 pounds (the limit of the gauge) almost instantly, or within two or three seconds, according to Mr. Edwards. The well was completed on the 19th of August, 1893, and after supplying the towns of Fairmont and Grafton, 25 miles distant, for four years, still showed a rock pressure at the well of 765 pounds, January 1, 1898, and of 550 pounds January 1, 1899. Its production through the open casing when first struck, must have been enormous, probably between 35 and 40 million cubic feet daily."

Lindsay Blaker No. 1 Well Record (536).

Mannington district, 0.7 mile northeast of Pleasantville. Authority, South Penn Oil Company.

(Elevation, 1115' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	15	15
Slate and shells	70	85
Coal, (Waynesburg "A")	2	87
Slate, limestone and sand	68	155
Trace of coal, (Waynesburg)	3	158
Gray sand (water)	10	168
Slate	10	178
Sand	25	203
Shale, blue	45	248
Slate, black	17	265
Slate	25	290
Limestone	25	315
Slate	25	340
Limestone	78	418
Slate	10	428
Coal, (Mapletown) (Sewickley)	2	430
Limy shells	10	440
Slate	40	480
Limestone and slate	20	500
Slate	30	530
Pittsburgh coal	8	538
Limestone	25	563
Slate and shells	60	623
Slate, pink	15	638
Slate, blue	30	668
Limy shells and slate	40	708

	Thickness. Feet.	Total. Feet.
Red rock	50	758
Slate, blue	30	788
Limy shells and slate	25	813
Slate, dark colored	20	833
Limy shells and slate	15	848
Dark colored clay	15	863
Slate, pink	10	873
Sandy shells and slate	40	913
Slate, pink	40	953
Slate, blue	35	988
Sand and shells	35	1023
Slate	15	1038
Limestone, blue	30	1068
Slate, blue	10	1078
Limestone	14	1092
Dunkard sand	10	1102
Limestone	20	1122
Slate	10	1132
Limestone	30	1162
Sand	20	1182
Slate, black	5	1187
Limestone, blue	20	1207
Limestone, brown	25	1232
Sand, white (Lower Freeport) (Gas sand)	83	1315
Trace of coal (Lower Kittanning)	2	1317
Slate	40	1357
Sand	25	1382
Slate (Salt sand, 1387')	10	1392
Limestone, brown	10	1402
Salt sand (salt water)	158	1560
Limestone, brown	10	1570
Slate, brown	20	1590
Limestone, brown	80	1670
Red rock	65	1735
Limy shells and slate	30	1765
Red rock	10	1775
Limestone, gray	7	1782
Slate	3	1785
Limestone (Big Lime)	72	1857
Sand, hard on top (Big Injun) (gas, 1870') 13'		
Sand 3		
Break of slate 4		
Sand 19	Big Injun 108	1965
Limestone, gritty 42		
Sand, gray 9		
Break of slate 3		
Sand (first oil, 1965') 15		

10" casing, 265'; 8¼" casing, 863'; 6¼" casing, 1092'; 4⅞" casing, 1842'.

M. S. Snodderly No. 1 Well Record (543).

Mannington district, 2 miles S 30° W of Mannington. Authority, South Penn Oil Company.

(Elevation, 1205′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	36	36
Unrecorded	601	637
Pittsburgh coal	...	637
Unrecorded	913	1540
Salt sand (gas, 1570′) and unrecorded	432	1972
Big Injun sand (gas, 2007′; first oil pay, 2069′; second oil, 2079′) and unrecorded to bottom	135	2107

10″ casing, 144′; 7⅝″ casing, 682′; 6¼″ casing (setter). 610′; 4⅞″ casing, 1570.

Pressure test in Salt sand at end of

1st minute, 160 lbs.	4th minute, 380 lbs.
2nd minute, 280 lbs.	5th minute, 390 lbs.
3rd minute, 350 lbs.	6th minute, 400 lbs.

Packed December 20, 1890, with 4′ anchor.
Shot in 1902 with 8 quarts; 10′ shell. top, 2069′.
Shot in 1902 with 10 quarts; 6′ shell, top, 2078′.

In addition to the brief logs as given in the table of wells for Marion county the much more complete records of the three wells listed below are given on the pages indicated of Vol. I(A) of the State Survey reports:

No. on Map.	Name of Well	Location.	Page of Vol. I(A).
520	Z. Kendall No. 3	Whetstone run, head of.	163
529	P. G. Hall No. 3	Pleasantville, 1.7 miles N 5° E of	164
535	Abram Ashcraft	Pleasantville, 1 mile NE of	175

No. 520 was Big Injun sand oil producer.
No. 529 had oil in both the Big Injun and Fourth, with gas in Fifty-foot.
No. 535 was a gasser in Gordon sand.

In the extreme edge of Mannington district the Clark Oil Company drilled a couple of small Thirty-foot oil producers. 1.5 miles westward from Pleasantville. The log of one of these wells—**Isabel Moore No. 1 (477)**—is published on page 188 of the Doddridge-Harrison report of the State Survey:

The detailed log of the J. C. Straight No. 2 well (519), located 3 miles southwest of Mannington, is published on pages 243 and 244 of Vol. 1 of the State Survey reports. It was an oil producer in the Fourth, with oil show in Big Injun and gas shows in the Fifth and Bayard sands.

The southeastern corner of Mannington district has been elevated to a relatively high structural level by the Wolf Summit anticline; hence, in that territory southeast of the Mannington oil pool there are 30-35 gas wells in which the Gordon, Fourth and Fifth sands appear to be the main producing horizons.

Prospective Oil and Gas Areas, Mannington District.—Mannington district has been more thoroughly prospected for oil and gas than any other in Marion county, yet there remain several scattered areas that are favored both by structure and development to warrant the drilling of test wells thereon. Taking up these areas roughly from northwest to southeast across the district, (1) that territory lying on the heads of Big and Campbell runs along the Marion-Wetzel county line appears favorable for oil in the Thirty-foot and Gordon sands; (2) that, 2 miles westward from Glover Gap on the waters of Beechlick, immediately along the axis of the Robinson syncline as outlined on Map II, for Big Injun gas, and Thirty-foot, Gordon and Fourth sand oil; (3) that, northward from Brink on the waters of Starkey run for Big Injun oil and for gas at the same horizon and in the deeper sands down to and including the Fourth; (4) that, immediately along the axis of the Robinson syncline southward from Evans' run to Owen Davy fork, for Maxton and Gordon oil; (5) that, northeastward from the main valley of Campbell run to the Marion-Monongalia county line between the 225 and the 250-foot contours of the Pittsburgh coal bed as outlined on Map II, for oil in the Gordon and Fourth sands; (6) that, included in the drainage of Dents and Rex runs between the 300 and the 350-foot contours of Pittsburgh coal, for Big Injun gas and Thirty-foot oil; (7) that, on the waters of Hibb's run northward from the 375-foot contour of Pittsburgh coal, would justify a further test for Fourth sand oil; (8) that, along both hillsides of Bartholomew fork southward from well No. 453 to the mouth of the stream, for Thirty-foot sand oil; (9) that, southwestward from Logansport to the head of Huey run along the east side of and adjacent to the 350-foot contour of Pittsburgh coal, Thirty-foot oil; (10) that,

northeastward from Margaret to the divide between Glade and Bingamon and westward from the 450 to the 375-foot contour of Pittsburgh coal, for oil at the same horizon; and (11) that, in the southeast corner of the district on the waters of Big run would justify several more wells for gas in the Big Injun and deeper sands.

Pawpaw District.

Pawpaw district adjoins Monongalia and occupies the northeast portion of Marion county. Its area is traversed by two structural folds as shown on Map II; viz., the Mooresville anticline and the Lambert syncline, the latter being very shallow on its western rim. The Mt. Morris-Fairview oil belt crosses the western portion of the district, in which the Big Injun and Bayard sands are main oil horizons. Eastward on the broad crest of the Mooresville arch there occurs a very important gas field of Marion county.

Taking up the development in Pawpaw from west to east, one-half dozen oil wells of the Flat Run oil pool are included within the extreme western point of the district. The log of the **Noah Price No. 1 well (351)**, located 0.4 mile southeast of Galletin, is published on pages 231-232 of Vol. I of the State Survey reports. It had an initial oil production of 300 barrels daily from the Fourth sand, along with a showing of oil and gas in the Big Injun and a show of gas in the Gantz sand.

Two miles eastward on the north hillside of State Road run, the **Joseph Michael No. 1 well (552)** is reported to have had a 4 to 5-barrel oil show in the Big Injun sand, according to Jasper Clayton, residing near the boring, who says that it was completed only to the Big Injun sand about 16 years ago

About 100 producing oil wells have been drilled within the boundaries of Pawpaw district in the Mt. Morris-Fairview oil belt. The data given on pages 141-142 and 156-157 of Vol. I(A) of the State Survey reports show that the Big Injun and Bayard (not the Fifth) sands are the principal oil horizons. The log of the **P. B. Amos No. 1 well (553)**, located in this field 1.2 miles northward from Fairview, is published on page

156 of the last mentioned report. Therein this well's initial production is given as 75 barrels daily from the Bayard sand.

The lasting qualities of the Bayard wells in this field are well illustrated by the M. E. Brookover No. 4 well, mentioned on page 157 of the same report, its initial production being 200 barrels daily in July, 1903, and still yielding 68 barrels daily on June 5, 1904. The four following records from wells scattered throughout this oil belt in Pawpaw give much data of interest.

David Jones No. 1 Well Record (554).

Pawpaw district, 0.9 mile north of Fairview. Authority, South Penn Oil Company. Completed January 6, 1891.

(Elevation, 1018′ L)	Thickness. Feet.	Total. Feet.
Unrecorded	473	473
Pittsburgh coal	...	473
Unrecorded	1346	1819
Big Injun sand (first pay, 1885′; second, 1900′) and unrecorded to bottom	110	1929

10″ casing, 108′; 8¼″ casing, 505′; 6⅝″ casing, 1047′; 5″ casing, 1736′.

Shot January 11, 1900, with 12 quarts; May 26, 1900, with 20 quarts; May 10, 1910, 20 quarts; 4¼″ x 6′ shell; top, 1899′.

The above well had an initial oil production of 40 bbls. daily from the Big Injun.

David Jones No. 5 Well Record (556).

Pawpaw district, 0.9 mile N 10° W of Fairview. Authority, South Penn Oil Company. Completed January 31, 1906.

	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	306	320
Coal, native, (Waynesburg)	4	324
Unrecorded	271	595
Coal, Mapletown (Sewickley)	7	602
Unrecorded	93	695
Pittsburgh coal	9	704
Unrecorded	521	1225
Dunkard sand and unrecorded	95	1320
Gas sand and unrecorded	320	1640
Salt sand (water, 1700′)	290	1930
Big Lime	60	1990
Big Injun sand (first pay, 2110′; second, 2133′)	190	2180
Unrecorded	430	2610
Gantz and Fifty-foot	100	2710
Unrecorded	407	3117
Bayard sand (pay 3118′, 10 bbls.)	20	3137
Unrecorded to bottom	6	3143

Shot July 5, 1906, with 20 quarts; Oct. 7, 1907, with 30 quarts; Sept. 7, 1911, with 20 quarts in 4¼" x 6'9" shell, top, 2109'; Sept. 19, 1911, with 20 quarts in 4¼ x 6'9" shell, top, 2131'.

G. W. Toothman No. 5 Well Record (557).

Pawpaw district, 0.6 mile north of Fairview. Authority, South Penn Oil Company. Completed May 21, 1893.

	Thickness. Feet.	Total. Feet.
Conductor	32	32
Unrecorded	543	575
Pittsburgh coal	...	575
Unrecorded	1340	1915
Big Injun sand (first pay, 1982'; second, 1993') and unrecorded to bottom	107	2022

10" casing, 600'; 8¼" casing, 792'; 6⅝" casing, 1667'; 5$\frac{3}{16}$" casing, 674'.

Shot March 1, 1895, with 3 quarts; July 3, 1895, with 4 quarts; Dec. 13, 1896, with 6 quarts; June 9, 1896, with 6 quarts; July 5, 1897, with 12 quarts; May 11, 1898, with 16 quarts; May 23, 1899, with 30 quarts; Sept., 1902, with 40 quarts; Nov. 22, 1909, with 40 quarts in two 4¼" x 6' 9" shells; top of first, 1992'; top of second, 1991'.

The initial production of the above, 1000 bbls. of oil daily from Big Injun, and it was still making 8 bbls. daily in August, 1911.

G. W. Toothman No. 1 Well Record (558).

Pawpaw district, 0.5 mile north of Fairview. Authority, South Penn Oil Company.

(Elevation, 1035' B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1780	1780
Big Injun sand (gas, 1795'; first pay, 1850'; second, 1875') and unrecorded to bottom	137	1917

Shot Feb. 28, 1893, with 30 quarts; Aug. 10, 1898, with 40 quarts; No. 6, 1908, with 20 quarts; 4¼" x 6'9" shell, top, 1849'; Nov. 9, 1908, with 20 quarts; 4¼" x 6'9" shell, top, 1850'.

Initial oil production, 8 bbls. daily, but only ½ bbl. daily in 1911, 21 years after completion.

The detailed log of the **P. W. Yost No. 1 well (560)**, located 0.5 mile west of Fairview, is published on pages 239-240 of Vol. I of the State Survey reports. This well had an initial oil production of 100 barrels daily from the Big Injun sand, and a fair oil show in the Gas sand, an account of which is given under the description of the latter formation, page 391.

Along the crest and a short distance down each slope of the Mooresville anticline there occurs a fine gas field in which

about 40 gassers have already been drilled. The five following records from wells therein show that the Big Injun, Thirty-foot, Fifth and Bayard sands are the main producing horizons:

Alice (Kuhn) Lamberton No. 1 Well Record (564).

Pawpaw district, 1.6 miles northeast of Fairview. Authority, Carnegie Natural Gas Company. Completed July 27, 1907.

(Elevation, 1140' B-A.T.)	Thickness. Feet.	Total Feet
Unrecorded	465	465
Pittsburgh coal	7	472
Unrecorded	1280	1752
Big Injun sand	178	1930
Unrecorded	920	2850
Bayard sand (little gas, 2858'-2867')	20	2870

10" casing, 484'; 8¼" casing, 1380'; 6⅝" casing, 1500'; 3" tubing, 2874.

Pressure test, first minute in 3" tubing, 100 lbs.

James Eddy No. 1 Well Record (569).

Pawpaw district, 2.2 miles northeast of Basnett. Authority, Carnegie Natural Gas Company. Completed Feb. 1, 1907.

(Elevation, 1065' B-A.T.)	Thickness. Feet.	Total Feet.
Unrecorded	400	400
Pittsburgh coal	...	400
Unrecorded	1280	1680
Big Injun sand (gas 1700-1810)	170	1850
Unrecorded	350	2200
Berea sand (gas, 2210')	45	2245
Unrecorded	502	2747
Fifth sand (gas, 2752')	23	2770
Unrecorded	4	2774
Bayard sand (little gas, 2785')	31	2805
Unrecorded to bottom	16	2821

10" casing, 456'; 8¼" casing, 1070'; 6⅝" casing, 1410'; 5⅜" casing, 1870').

W. R. Toothman No. 1 Well Record (572).

Pawpaw district, 1.2 miles east of Basnett. Authority, Carnegie Natural Gas Company. Completed Aug. 24, 1911.

(Elevation, 1215' B-A.T.)	Thickness. Feet.	Total Feet.
Unrecorded	490	490
Coal, Pittsburgh	...	490
Unrecorded	1350	1840
Big Injun sand (some gas at 1928')	113	1953
Unrecorded	532	2485
Thirty-foot sand (little gas, 2495')	35	2520

	Thickness. Feet.	Total. Feet.
Unrecorded	190	2710
Gordon sand	25	2735
Unrecorded	51	2786
Fifth sand (gas, 2790')	12	2798
Unrecorded to bottom	70	2868

Pressure test:

1st ½ minute, 165 lbs. 3rd minute, 340 lbs.
1st minute, 225 lbs. 4th minute, 360 lbs.
2nd minute, 290 lbs.

A. T. Hibbs No. 1 Well Record (571).

Pawpaw district, 2 miles east of Basnett. Authority, Hope Natural Gas Company. Completed April 2, 1898.

(Elevation, 1184' L-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	20	20
Unrecorded	296	316
Pittsburgh coal	...	316
Unrecorded	1298	1614
Big Injun sand (light gas, 1711'; fair gas, 1717')	133	1747
Unrecorded	518	2265
Gantz sand and unrecorded	48	2313
Thirty-foot sand (fair gas)	30	2343
Unrecorded	252	2595
Fifth sand (gas, 2595') and unrecorded	35	2530
Lime, slate and shells to bottom	20	2750

10" casing, 437'; 8¼" casing, 1265'; 6⅝" casing, 1375'; 5 3/16" casing, 1614'.

W. G. King No. 1791 Well Record (574).

Pawpaw district, 1.8 miles southeast of Fairview. Authority, Hope Natural Gas Company. Completed January 1, 1907.

(Elevation, 972' L-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Unrecorded	126	140
Coal, Mapletown (Sewickley)	...	140
Unrecorded	102	242
Pittsburgh coal	...	242
Unrecorded	1268	1510
Big Lime	60	1570
Big Injun sand (gas, 1690')	230	1800
Unrecorded	315	2115
Berea sand	30	2145
Unrecorded	15	2160
Fifty-foot sand	55	2215
Unrecorded	35	2250
Thirty-foot sand (gas, 2260')	25	2275
Unrecorded	95	2370
Gordon Stray sand	25	2395
Unrecorded	30	2425
Gordon sand	20	2445
Unrecorded (no Fourth sand)	190	2635
Bayard sand (gas in top)	22	2657
Unrecorded to bottom	88	2745

Several widely scattered wells have been drilled on the east side of the axis of the Lambert syncline in Pawpaw, the most of which are gassers, since this portion of the district occupies a relatively high structural level. The four following records give a large fund of information on this region:

Ulysses M. Price No. 1 Well Record (577).

Pawpaw district, 1.1 miles southeast of McCurdyville. Authority, Hope Natural Gas Company. Completed Aug. 23, 1904.

	Thickness. Feet.	Total. Feet.
Unrecorded	711	711
Coal, Mapletown (Sewickley)	..	711
Unrecorded	89	800
Coal, Pittsburgh	..	800
Unrecorded	1310	2110
Red rock and unrecorded	17	2127
Big Injun sand (light gas, 2165'; strong gas, 2228') and unrecorded	823	2950
Gordon sand and unrecorded	50	3000
Fourth sand and unrecorded	210	3210
Bayard sand (oil) and unrecorded to bottom	235	3445

6⅝" casing, 2060'; 5⅜" casing, 2411'.

The above well had an initial oil production of 7 to 8 bbls. daily from the Bayard.

Jonathan Eddy No. 1 Well Record (578).

Pawpaw district, 1.1 mile S 30° E of McCurdyville. Authority, Hope Natural Gas Company.

(Elevation, 1050' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	20	20
Unrecorded	370	390
Pittsburgh coal	...	390
Unrecorded	1290	1680
Big Injun sand (gas, 1685', 1787') and unrecorded to bottom	131	1811

7⅝" casing, 435'; 6⅝" casing, 1040', 4⅞" casing, 1638'; 2" tubing, 1740'.

Shot July 30, 1901, with 10 quarts of nitro-glycerine.

The above well starts flush with the Elm Grove limestone, and it has an initial gas production of 10,000,000 cu. ft. daily.

Alpheus (J. L.) Fluharty No. 1 Well Record (581).

Pawpaw district, 0.7 mile northeast of Gray's Flat. Authority, Hope Natural Gas Company. Completed Nov. 2, 1910.

(Elevation, 1030′ B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	322	338
Pittsburgh coal (steel line measurement)	8	346
Unrecorded	888	1234
Second Salt sand (water, 1272′)	128	1362
Unrecorded	232	1594
Big Lime	69	1663
Big Injun sand (gas, 1750′-1754′) steel line measurement.	195	1858
Squaw sand	54	1912
Unrecorded	250	2162
Berea, Gantz and Fifty-foot sands (steel line measurement)	150	2312
Unrecorded	48	2360
Thirty-foot sand (steel line measurement)	32	2392
Unrecorded	161	2553
Gordon sand (steel line measurement)	29	2582
Unrecorded	100	2682
Fifth sand (steel line measurement)	34	2716
Unrecorded to botton (steel line measurement)	349	3065

10″ casing, 376′; 8¼″ casing, 1346′; 6⅝″ casing, 1667′; 5 3/16″ casing, 2556′.

Shot Nov. 10, 1910, with 100 quarts; shell 5″x25′; top of shell, 1746′.

Test before shot 6/10 water in 1″ pipe. Test 2 hours after shot, 10/10 water in 1″ pipe 8¼″x5 3/16″ Dresser Packer at 1667′

J. W. Williams No. 1 Well Record (585).

Pawpaw district, 1.4 miles west of Arnettsville. Authority, West Virginia Traction & Electric Company. Completed Aug. 12, 1911.

(Elevation, 1199′ L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	14	14
Slate, sand, lime, no coal	336	350
Sand, (Sewickley)	40	390
Sewickley coal	5	395
Lime	40	435
Slate	53	488
Pittsburgh coal	7	495
Slate, black, lime, sand, and no coal	10	505
Lime, slate, sand no coal	325	830
Moundsville sand (gas, 860′)	50	880
Slate and shells, lime and sand, no coal	455	1235
Gas sand (gas. 1252′)	40	1275
Slate and shells	35	1310
First Salt sand	52	1362
Slate and shells	20	1382
Lime	16	1398
Salt sand (water, 1481′)	106	1504
Slate and shells	58	1562
Maxton sand	18	1580
Lime, red	110	1690

	Thickness. Feet.	Total. Feet.
Slate and shells	57	1747
Little Lime	25	1772
Pencil cave	10	1782
Big Lime	74	1856
Big Injun sand (gas, 1951')	116	1972
Slate and shells, white	85	2057
Sand, (Squaw)	65	2122
Slate and shells, black	93	2215
Berea Grit	28	2243
Slate and shale, white	103	2346
Gantz sand (gas, 2366')	33	2379
Slate, black	9	2388
Fifty-foot sand	118	2506
Slate, red	18	2524
Thirty-foot sand	12	2536
Slate and shells, red	29	2565
Slate and shells, black	55	2620
Slate and shells, red	63	2683
Shells	3	2686
Slate, black	5	2691
Gordon Stray sand	4	2695
Slate, black	12	2707
Gordon sand	6	2713
Slate, black	32	2745
Lime	20	2765
Fourth sand	12	2777
Slate, black	28	2805
Sand, brown	22	2627
Slate, white	34	2861
Sand, white	6	2867
Slate, black	4	2871
Fifth sand	51	2922
Slate, white and unrecorded to bottom	105	3025

10" casing, 517' 2"; 8¼" casing, 1496' 3"; 6⅝" casing, 1811'.

On Little Pawpaw creek north from Stafford two very shallow wells have been drilled for gas. The **Wm. R. Clayton No. 1 well (587)**, located 0.7 mile north of Stafford, was drilled to a depth of only 40 feet in October, 1909. A pay of gas was struck at a depth of 30 feet, and another at 40 feet in what appears to be the Arnoldsburg sandstone, since the well mouth is about 125 feet above the Sewickley coal. According to Mrs. Clayton, sufficient gas was obtained to furnish fuel for 2 heating stoves, 1 cook stove and 4 lights. No trouble is experienced in freezing of pipes, and the volume appeared as strong in September, 1911, as at first.

The **New Central Coal Co. No. 3 (588) well**, located one-fourth mile north of Stafford, obtained its gas in the Sewickley coal at a depth of 125 feet, according to G. S. Phillips,

Superintendent. The rock pressure was 11 pounds to the square inch. Two other shallow wells have been drilled by this company, and the three, in September, 1911, had been furnishing gas for 6 years for fuel and lights in the dwelling houses of the officials of the corporation.

Prospective Oil and Gas Areas, Pawpaw District.—The western half of Pawpaw has been quite thoroughly tested for oil and gas, but the results of test wells in the eastern portion have not been so encouraging. There are, however, a few scattered areas that would warrant further search for these hydro-carbons. (1) That territory lying eastward from Basnett to the dividing ridge on the east side of Laurel run, appears favorable for gas in the Big Injun and deeper sands; (2) that, in the northeast corner of the district on the waters of Chunk run for Bayard sand oil; and (3) that, on the waters of Little Pawpaw and Minister's run northward from the mouth of the latter stream and southward from the 700-foot contour of Pittsburgh coal as outlined on Map II for oil in the Fifth and Bayard, situated as it is on a marked structural terrace.

Lincoln District.

Lincoln district lies immediately southwest from Pawpaw district and its area is traversed by three structural folds; viz., the Wolf Summit and Mooresville anticlines and the Shinnston syncline. Located as it is at a high structural level immediately southeast of the Mannington oil field, the greatest gas pools of Marion county are included within its borders, especially in the southern half of its area. The Mt. Morris-Fairview oil belt extends in a northeast-southwest direction entirely across its northwest corner. The oil and gas development therein will now be discussed roughly from northwest to southeast across the district.

About 100 wells, 90 to 95 per cent of which were oil producers, have been drilled in the Mt. Morris-Fairview oil belt within the boundaries of Lincoln. The seven following records from wells scattered throughout the field give much data of economic interest:

William Wallace No. 1 Well Record (591).

Lincoln district, 2.1 miles southwest of Fairview. Authority, Hope Natural Gas Company.

(Elevation, 1110' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	18	18
Slate, white and soft	80	98
Sand, brown, soft, (Mannington)	27	125
Slate, white and soft	15	140
Sand, Waynesburg, white, sharp (water all through)	57	197
Coal, Waynesburg	2	199
Slate, white and soft	3	202
Limestone, gray, hard	5	207
Slate, white and hard	15	222
Limestone, gray, hard	10	232
Slate, white, hard	20	252
Limestone, gray, hard	20	272
Slate, white, hard	10	282
Limestone, gray, hard	20	302
Slate, white, hard	20	322
Limestone, gray and hard	30	352
Slate, gray and hard	20	372
Limestone, gray and hard	20	392
Slate, gray and hard	10	402
Limestone	30	432
Slate, white, hard	10	442
Sand, white, soft	28	470
Coal, Mapletown (Sewickley)	10	480
Limestone, gray and hard	30	510
Slate, white and soft	15	525
Limestone, gray, hard	20	545
Slate, gray, hard	15	560
Limestone, gray, hard	20	580
Slate, black	10	590
Coal, Pittsburgh	11	601
Slate, white	20	621
Limestone	10	631
Slate, white	10	641
Sand, white, hard	15	656
Limestone	10	666
Slate	10	676
Limestone, gray	25	701
Slate, gray	10	711
Limestone	20	731
Slate	20	751
Red rock	10	761
Slate, white and soft	40	801
Red rock	65	866
Limestone, gray, hard	10	876
Slate, white and soft	24	900
Red rock	40	940
Sand, dark, soft	25	965
Slate, white, soft	135	1100
Slate, dark	30	1130
Sand, dark	10	1140
Limestone, dark, hard	20	1160

	Thickness. Feet.	Total Feet.
Slate, white, soft	5	1165
Sand, white (Upper and Lower Freeport)	170	1335
Slate and limestone	50	1385
Sand, white	52	1437
Slate, very soft	133	1570
Salt sand	15	1585
Slate	25	1610
Sand	20	1630
Slate	35	1665
Limestone	20	1685
Slate	25	1710
Sand, black	25	1735
Red rock	60	1795
Limestone	20	1815
Red rock	7	1822
Limestone (Big Lime)	90	1912
Sand, white....49		
Limestone, white, hard....10.5		
Slate, dark, hard....11		
Sandstone, white very hard.14		
Sand, hard....8.5	Big Injun	148 2060
Sand, coarse....3		
Slate, red....1		
Sandstone, hard, white....24		
Slate....19		
Sand, hard....8		
Sand and shells to bottom		

10⅝" casing, 199'; ——" casing, 1799'.

W. M. Billingslea No. 1 Well Record (592).

Lincoln district, 1.4 miles N 30° E of McClellan. Authority, South Penn Oil Company. Completed August 31, 1896.

(Elevation, 1095' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	542	542
Pittsburgh coal		542
Unrecorded	1308	1850
Big Injun sand (oil pay, 1952') and unrecorded to bottom	125	1975

10" casing, 572'; 8¼" casing, 1332'; 6⅝" casing, 1845'.

Shot Mar. 10, 1897, with 16 quarts; January, 1898, with 24 quarts; Jan, 21, 1899, with 30 quarts; and Feb. 14, 1908, with 40 quarts in 2-20 quart shells; top of first 1952'; top of second, 1949'.

Benjamin Huffman No. 3 Well Record (594).

Lincoln district, 0.4 mile northwest of McClellan. Authority, South Penn Oil Company.

	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded (water well, 100')	528	544
Pittsburgh coal	8	552
Unrecorded	1255	1807

	Thickness. Feet.	Total. Feet.
Big Lime	80	1887
Big Injun sand (oil, 1961') and unrecorded to bottom	123	2010

10" casing, 176'; 8¼" casing, 994'; 6⅝" casing, 1887'.
Shot June 1899, with 12 quarts; 4' shell, top, 1960'.
Shot Dec. 3, 1901, with 15 quarts, 6' shell, top, 1960'

A. O. Talkington No. 2 Well Record (596).

Lincoln district, 1.6 miles north of Downs. Authority South Penn Oil Company. Completed Aug. 3, 1891.

	Thickness. Feet.	Total. Feet.
Conductor	24	24
Unrecorded	541	565
Pittsburgh coal	10	575
Unrecorded	1295	1870
Big Lime	40	1910
Big Injun sand (first oil pay, 2012'-2044') and unrecorded to bottom	130	2040

10" casing, 196'; 8¼" casing, 1105'; 6⅝" casing, 1558'; 5⅜" casing, 1920'.
Shot Aug. 19, 1891, with 6 quarts; 4' shell.
Shot Nov. 26, 1894, with 12 quarts; 10' shell, top, 2012'.

The above well starts 15 feet above the Washington coal, according to Reger.

The detailed log of the **Rezin Amos No. 1 well (599)**, located on Mod run, 1.3 miles north of Downs is published in full in connection with the section for the latter place, page 134. It was an oil producer from the Big Injun sand.

N. Beaty No. 17 Well Record (603).

Lincoln district, 1 mile northwest of Downs. Authority, McCune Oil Company.

(Elevation, 1170' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	600	600
Pittsburgh coal	...	600
Unrecorded (first oil pay in **Big Injun**, 2029'; second pay 2036')	1900	2500
Gantz sand and unrecorded	30	2530
Fifty-foot sand and unrecorded	320	2850
Fourth sand (gas, 2858') and unrecorded	140	2990
Bayard sand (gas, 2995') and unrecorded to bottom	70	3060

John Eagan No. 3 Well Record (605).

Lincoln district, 0.9 mile north of Downs. Authority, Leonard Brown & Company.

(Elevation, 1310′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	715	715
Pittsburgh coal	...	715
Unrecorded and Injun sand (oil show, 2162′; second measure, 2182′)	1486	2201
Unrecorded	444	2645
Fifty-foot sand and unrecorded	302	2947
Fourth sand (oil, 2950′)	23	2970
Unrecorded	10	2980
Fourth sand and unrecorded	144	3124
Bayard sand (gas, 3125′)	12	3136

8¼″ casing, 1243′; 6⅝″ casing, 2057′; rock pressure 900 lbs.

Festus Downs No. 4 Well Record (606).

Lincoln district, 0.5 mile north of Downs. Authority, Leonard Brown & Company.

(Elevation, 1100′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	485	485
Pittsburgh coal	...	485
Unrecorded (first oil pay, 1985′) and **Big Injun sand**	1475	1960
Unrecorded	457	2417
Fifty-foot sand	46	2463
Unrecorded	255	2718
Fourth sand (oil, 2727′) and unrecorded to bottom	17	2735

6⅝″ casing, 1484′; sand liner in pencil cave, 1818′.
"Initial production, 70 bbls. daily."

Along the crests and down the slopes of the Wolf Summit and Mooresville anticlines about 250 gas wells have been drilled within the boundaries of Lincoln district. The nine following records from wells scattered throughout this great field show that the Big Injun, Fifty-foot, Thirty-foot, Fourth, Fifth and Bayard sands are the main gas producing horizons:

A. B. Morgan No. 1 Well Record (622).

Lincoln district, 0.8 mile southeast of Farmington. Authority, Carnegie Natural Gas Company. Completed Nov. 20, 1911.

(Elevation, 1150′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	470	470
Coal, Pittsburgh	9	479
Unrecorded	1365	1844
Big Injun sand	111	1955
Unrecorded	901	2856
Fifth sand (gas, 2872′)	23	2879
Unrecorded to bottom	37	2916

40 lbs. pressure in 2″ tubing.

The gas pay is evidently in the Fifth sand, since this horizon belongs about 1,000 feet below the top of the Big Injun, while the Bayard belongs about 1100 feet below the same datum plane. In this portion of Marion county, the old Pittsburgh coal—Bayard interval (2400 feet) does not continue to hold good owing to the increased thickness of the Pottsville and Mauch Chunk series.

John W. Criss No. 1 Well Record (624).

Lincoln district, 1.6 miles southwest of Farmington. Authority, Carnegie Natural Gas Company. Completed July 14, 1906.

(Elevation, 975' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	275	275
Coal, Pittsburgh	9	284
Unrecorded	1372	1656
Big Injun sand	140	1796
Unrecorded	683	2479
Gordon sand	26	2505
Unrecorded	65	2573
Fourth sand	22	2595
Unrecorded	100	2695
Fifth sand gas, 2697' and 2703')	19	2714

6¼" casing, 1630'; 5⅜" casing, 1855'; 3" tubing, 2714'.

First Pressure test in 3" tubing:

1st minute, 230 lbs.	4th minute, 490 lbs.
2nd minute, 340 lbs.	5th minute, 500 lbs.
3rd minute, 425 lbs.	Rock pressure, 640 lbs.

The **H. L. Sturm No. 1 well (626)**, completed in 1905 and located 1.2 miles southeast of Downs, gaged 2.4 inches mercury in 5 3/16" casing, from the Fifth sand, according to data given Mr. Reger, being equivalent to 5,400,000 cu. ft. of gas daily.

James Morgan (Silas Stark) No. 1894 Well Record (627).

Lincoln district, 1.1 miles northwest of Annabelle. Authority, Philadelphia Company. Completed June 28, 1906.

(Elevation, 1112' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	302	302
Mapletown (Redstone) coal and unrecorded	26	328
Pittsburgh coal	...	328
Unrecorded	1205	1533
Maxton sand (oil show)	77	1610
Unrecorded	70	1680
Big Injun sand (gas) and unrecorded to bottom	33	1713

"Original minute pressure in Big Injun, 145 lbs."

M. M. Martin No. 2121 Well Record (630).

Lincoln district, 0.7 miles N 20° W of Bingamon. Authority, Philadelphia Company.

(Elevation, 1045′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	300	300
Pittsburgh coal	5	305
Unrecorded	85	1690
Big Injun sand	110	1800
Unrecorded	712	2512
Fourth sand (gas, 2518′; oil, 2520′)	33	2545
Unrecorded	138	2683
Fifth sand (gas, 2685′)	4	2687

A. A. Parrish No. 805 Well Record (635).

Lincoln district, 1 mile N 35° E of Annabelle. Authority, Hope Natural Gas Company.

(Elevation, 1285′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	480	480
Native coal (Sewickley)	6	486
Unrecorded	114	600
Pittsburgh coal	8	608
Unrecorded	907	1515
Salt sand (water, 1540′-1590′)	160	1675
Unrecorded, (Maxton sand, shells only)	190	1865
Little Lime	15	1880
Pencil cave	10	1890
Big Lime	81	1971
Big Injun sand (gas, 2062′-2063′)	34	2105
Unrecorded	415	2520
Fifty-foot sand	80	2600
Unrecorded (**gas in Thirty-foot sand**)	195	2795
Gordon Stray sand	35	2830
Unrecorded	6	2836
Gordon sand	14	2850
Unrecorded	25	2875
Fourth sand	15	2890
Unrecorded	103	2993
Fifth sand	12	3005
Unrecorded to bottom	50	3055

8¼″ casing, 1628′; 6⅝″ casing, 1950′ 5$\frac{3}{16}$″ casing, 2865′.

W. S. Parrish No. 2197 Well Record (639).

Lincoln district, 0.7 mile N 30° W of Festus. Authority, Hope Natural Gas Company.

(Elevation, 1240′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	453	453
Mapletown (Sewickley) coal	4	457
Unrecorded	113	570
Pittsburgh coal	7	577

	Thickness. Feet.	Total. Feet.
Unrecorded	1083	1460
Salt sand (water, 1485'-1515')	160	1620
Unrecorded	236	1856
Little Lime	10	1866
Pencil cave	6	1872
Big Lime	93	1965
Big Injun sand	75	2040
Unrecorded	455	2495
Fifty-foot sand (gas, 2504')	60	2555
Unrecorded	10	2565
Thirty-foot sand	35	2600
Unrecorded (Gordon Stray sand, shells only)	167	2767
Gordon sand	25	2792
Unrecorded	13	2805
Fourth sand	20	2825
Unrecorded	132	2957
Fifth sand (gas, 2966') and unrecorded to bottom	75	3032

10" casing, 622'; 8" casing, 1495'; 6⅝", 1900'; 5" casing, 2770'; 2" tubing, 3032'.

"Rock pressure in Fifty-foot sand, 640 lbs.; rock pressure in Fifth sand, 250 lbs. per sqare inch."

A. Martin No. 2165 Well Record (640).

Lincoln district, at Annabelle. Authority, Hope Natural Gas Company. Completed May 19, 1911.

(Elevation, 1155' B-A. T.)	Thickness. Feet.	Total Feet.
Unrecorded	280	280
Mapletown (Sewickley) coal	5	285
Unrecorded	115	400
Pittsburgh coal	7	407
Unrecorded	893	1300
Salt sand (water, 1310')	180	1480
Unrecorded, (Maxton sand, lime shells only)	200	1680
Little Lime	12	1692
Pencil cave	8	1700
Big Lime	88	1788
Big Injun sand (gas, 1830')	72	1860
Unrecorded	930	2790
Fifth sand (gas, 2790')	17	2807
Unrecorded to bottom	155	2962

10" casing, 450'; 6" casing, 1750'; 5" casing, 2567'.

E. H. Stevens No. 2138 Well Record (642).

Lincoln district, 0.5 mile east of Sturm's Mill. Authority, Philadelphia Company.

(Elevation, 1033' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	70	70
Mapletown (Sewickley) coal	3	73
Unrecorded	117	190
Pittsburgh coal	4	194

	Thickness. Feet.	Total. Feet.
Unrecorded	1436	1630
Big Injun sand	50	1680
Unrecorded	730	2410
Gordon sand	44	2454
Unrecorded	136	2590
Fifth sand (gas, 2595')	10	2600
Unrecorded to bottom	13	2613

Marvin Tetrick (Eleon Straight) No. 2148 Well Record (651).

Lincoln district, 1.4 miles west of Worthington. Authority, Philadelphia Company. Completed May 4, 1907.

(Elevation, 1220' B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	348	348
Mapletown (Sewickley) coal	...	348
Unrecorded	112	460
Pittsburgh coal	...	460
Unrecorded	1403	1863
Big Injun sand	90	1953
Unrecorded	637	2690
Gordon sand	14	2704
Unrecorded	134	2838
Shells (gas) and unrecorded	7	2845
Fifth sand (gas)	10	2855
Unrecorded to bottom	26	2881

"Original minute pressure, 55 lbs.; rock pressure, 865 lbs."

The following wells in this region were published in Vol. I(A) of the State Survey Reports:

No. on Map II.	Name of Well.	Location.	Page of Vol. I(A).
610	Hunter Atha No. 1	On Dunkard Mill run	155
612	Jack Connor No. 1	On Dunkard Mill run	154
615	E. W. Hamilton No. 1	Downs, 1.7 miles NE of	155

No. 610 in the above table was a Bayard sand gasser with a rock pressure of 1100 lbs. to the sq. in. The 1st minute pressure was 200 lbs.; the 2nd, 350 lbs.; and the 16th, 1060 lbs.

No. 612 was a Bayard gasser, having a pressure for the 1st minute of 275 lbs. to the sq. in.; the 2nd, 440 lbs.; the 5th, 740 lbs.; the 8th, 900 lbs.; the 10th, 935 lbs.; and the 15th, 950 lbs.

No. 615 had gas pays in the Big Injun, Fifty-foot, Fourth and Bayard sands.

Prospective Oil and Gas Areas, Lincoln District.—Lincoln district has been quite thoroughly drilled in its southern half for gas, but in the northern portion there remains a large acreage that both by structure and development warrants the drilling of more wells for gas. (1) That on the waters of

Dunkard Mill and Davy runs southward from Upton to Buffalo creek appears favorable for gas in the Big Injun and deeper sands; (2) that, along the Clarksburg pike southwestward from Monongah, for several more gassers; and (3) that, southward from Sturm's Mill on the head of Long run, for a half dozen more gas wells.

Fairmont District.

Fairmont district occupies that portion of Marion county lying west of the Monongahela river, south of Pawpaw district and east of Lincoln district; hence, its area, with the exception of a narrow strip along the extreme western border, lies in the Lambert synclinal basin. The Mooresville anticline traverses in a north and south direction the western point of the district. Only seven wells, four of which were dry holes, have been drilled therein. The three producers are gassers along the western border.

The following is the record of a dry hole down near the axis of the Lambert syncline:

Lewis Hall No. 1 Well Record. (665).

Fairmont district, 1.4 miles N 20° W of Barrackville. Authority, Philadelphia Company. Completed in 1911.

(Elevation, 1065' B-A. T.)	Thickness. Feet.	Total. Feet.
Clay	13	13
Bluff sand	45	58
Slate, dark	67	125
Lime	150	275
Slate, dark	25	300
Coal, Mapletown (Sewickley)	5	305
Lime (steel line measurement)	112	417
Pittsburgh coal	9	426
Lime	20	446
Slate and shell	135	581
Red rock	40	621
Lime	94	715
Slate, dark	70	785
Sand, (Moundsville)	20	805
Slate, dark	80	885
Little Dunkard sand	40	925
Slate and shell	225	1150
Sand, white	20	1170
Slate, dark	50	1220
First Salt sand	55	1275

	Thickness. Feet.	Total. Feet.
Slate	50	1325
Second Salt sand	115	1440
Slate	70	1510
Red rock	60	1570
Slate	70	1640
Lime	15	1655
Red rock	20	1675
Little Lime	15	1690
Pencil, black	6	1696
Big Lime	79	1775
Big Injun, white, hard (steel line measurement)	95	1870
Slate, black	70	1940
Sand, white, (Squaw)	60	2000
Slate and shell	254	2254
Sand, (Gantz) white and hard (steel line measurement)	41	2295
Slate and shell	188	2483
Thirty-foot sand, white and hard (steel line measurement)	20	2503
Red rock	22	2525
Slate and shale	81	2606
Gordon sand, white and hard (steel line measurement)	15	2621
Slate, dark, soft	46	2667
Fourth sand, white, hard	20	2687
Slate and shells, light	72	2759
Fifth sand, dark, soft	25	2784
Slate, white, soft	142	2926
Lime, white, hard	5	2931
Slate, white, soft, to bottom	96	3027

The detailed log of the **Eli M. Rex No. 1 well (664)**, located on Finch's run in the northern part of Fairmont district, is published on pages 152-154 of Vol. I(A) of the State Survey reports. This well reached a depth of 2498 feet below the Pittsburgh coal with out getting either oil or gas in paying quantity.

No information was obtained as to the dry holes (Nos. 670 and 671) in the vicinity of Barrackville.

Prospective Oil and Gas Areas, Fairmont District.—The results of drilling operations in this district have not been very encouraging, but there yet remains a considerable acreage that would justify more test wells for gas. (1) That portion lying on the waters of Davy run appears favorable for gas in the Big Injun and deeper sands; and (2) that southward from the main line of the Baltimore & Ohio Railroad and west of a meridian line through the Morgan-Billingslee Coal Test Well No. 8 (669), is prospective territory for gas at the same horizons.

Winfield and Union Districts.

About the same geologic and structure conditions prevail in Winfield and Union districts, Marion county, as mentioned on a preceding page for the eastern portions of Union, Morgan and Clinton districts, Monongalia, since, with the exception of a small acreage on the southeast border, their entire area lies along the steep western slope of the same great anticlinal fold; viz., Chestnut Ridge. The results of drilling therein have been very discouraging to the oil and gas operators. Twelve wells have been bored within their boundaries—7 in Winfield and 5 in Union—and only one light gasser has resulted. The developments will now be discussed from north to south across the districts:

F. M. Meredith No. 1 Well Record (682).

Winfield district, 2 miles northeast of Fairmont. Authority, Anthony Bowen.

(Elevation, 1100′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	480	480
Freeport (Brush Creek) coal	8	488
Unrecorded	14	502
Big Dunkard sand (slight oil and gas show)	26	528
Unrecorded	142	670
Gas sand	62	732
Unrecorded	3	735
Salt sand (water, 735′; hole full at 788′)	65	800
Unrecorded	408	1208
Big Lime	142	1410
Big Injun sand (slight oil show)	130	1540
Unrecorded	400	1940
Fifty-foot and Thirty-foot sand (oil show in Fifty-foot)	70	2010
Unrecorded	353	2363
Fifth sand (oil show; pebbles, 2383′-2390′)	30	2393
Unrecorded	57	2450
Bayard sand	36	2486
Unrecorded to bottom	4	2490

The Gordon, Gordon Stray and Fourth sands not well defined. Considered shelly and broken.

10″ casing, 258′; 8¼″ casing, 1275′.

The above record starts 68 feet by hand-level below the Pittsburgh coal, according to Reger.

The detailed log of the **Brent S. Jones No. 1 well (682A)**, located 1.5 miles due south of Smithtown on the south bank

of Whiteday creek, is published on pages 151-152 of Vol. I(A) of the State Survey reports. This well starts 15 feet by hand-level below the Upper Freeport coal, hence the correlations of coals as published in that report should be corrected accordingly. The boring reached a deph of 3150 feet below the Pittsburgh coal, and penetrated the Elizabeth sand.

The detailed log of the **A. Boutlou No. 1 well (666)**, completed during 1912 and located on the south side of the river, 0.6 mile southwest of Rivesville, is published on page 143, in connection with the Montana Mines section.

Vincent Heirs No. 2010 Well Record (683)

Winfield district, 0.6 mile east of Samaria. Authority, Hope Natural Gas Company. Completed Mar. 21, 1911.

(Elevation, 1114′ L-A.T.)	Thickness. Feet.	Total Feet.
Unrecorded (conductor, 16 feet.)	10	10
Sand, (Upper Connoquenessing)	54	64
Coal, (Quakertown)	7	71
Gas sand, (Lower Connoquenessing)	49	120
Unrecorded	5	125
Sand, (Sharon)	75	200
Red rock and lime	90	290
Unrecorded	20	310
Sand, (Maxton) (6 bailers salt water 354′)	50	360
Unrecorded	20	380
Sand (3 bailers water, 395′)	20	400
Red rock	105	505
Little Lime	20	525
Pencil cave	15	540
Red rock	6	546
Big Lime	78	624
Red rock	3	627
Slate and shells	31	658
Big Injun sand (gas at 728′, 736′, 738′ to 748′)	142	800
Unrecorded	5	805
Squaw sand	32	837
Gantz sand?	338	1175
Sand, (Berea)	15	1190
Unrecorded	5	1195
Sand, (Gantz)	85	1280
Unrecorded	33	1313
Sand, (Thirty-foot)	24	1337
Unrecorded	14	1351
Sand, (Stray)	14	1365
Unrecorded	9	1374
Sand	6	1380
Unrecorded	50	1430
Red rock	209	1639
Sand, (Fifth)	17	1656

	Thickness. Feet.	Total. Feet.
Red rock	61	1717
Sand, (Bayard)	11	1728
Lime and slate, brown and gray	520	2248
Lime and shale	402	2650
Sand shells, shale and gritty lime	150	2800
Lime and shale	50	2850
Lime	90	2940
Slate and shells to bottom	460	3400

10" casing, 298'; 8¼" casing, 589'; 6⅝" casing, 2266'.

"Pressure test: 3/10 water on 2" opening, equivalent to 82,000 cu. ft. daily."

The above well record starts approximately 900 feet below the Pittsburgh coal horizon, nearly flush with the top of the Upper Connoquenessing sandstone, cropping at the well. The boring evidently penetrated Devonian rocks from 1190 to 3400 feet—2310 feet—probably stopping in the Hamilton shales.

J. F. Vangilder No. 1 Well Record (688).

Union district, 1.6 miles east of Kingmont. Authority, George E. Miller & Company. Completed October 17, 1911.

(Elevation, 975' B-A.T.)	Thickness. Feet.	Total Feet.
Unrecorded	305	305
Coal, (Brush Creek)	3	308
Unrecorded	71	379
Dunkard sand	39	418
Unrecorded	27	445
Sand	50	495
Unrecorded	21	516
Gas sand	48	564
Unrecorded	19	583
Coal, (Lower Kittanning)	7	590
Unrecorded	31	621
Sand, (II Cow Run)	71	692
Unrecorded	9	701
Salt sand	169	870
Unrecorded	30	900
Limestone	30	930
Unrecorded	243	1173
Little Lime	16	1189
Pencil cave	11	1200
Big Lime	90	1290
Big Injun sand (oil show, 1395'-1401')	122	1412
Unrecorded	149	1561
Sand, (Squaw)	13	1574
Unrecorded	226	1800
Fifty-foot sand (not extra good, but no breaks)	62	1862
Unrecorded	8	1870
Thirty-foot sand (shelly)	30	1900

	Thickness. Feet.	Total. Feet.
Unrecorded	115	2015
Gordon sand (gas pocket, 2023'; exhausted after drilling through sand)	11	2026
Unrecorded	143	2269
Fifth sand (nice show of gas that did not exhaust)	23	2292
Unrecorded	39	2331
Bayard sand (could smell oil in sand pumpings after washing them thoroughly)	53	2384

The above well starts about 225 feet below the Pittsburgh coal, and was abandoned as a dry hole.

W. R. Jasper Heirs No. 1 Well Record (687)

Union district, at Colfax. Authority, J. W. McDonald et al. Completed July 23, 1910.

(Elevation, 926' L-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	59	75
Freeport coal (Upper)	5	80
Unrecorded	14	94
Sand	46	140
Unrecorded	80	220
Sand	32	252
Kittanning coal (Lower)	10	262
Unrecorded (water, 360')	98	360
Sand	40	400
Lower Kittanning (Mercer) coal	6	406
Unrecorded	106	512
Slate and lime	43	555
Salt sand	125	680
Unrecorded	70	750
Red rock	110	860
Little Lime	30	890
Pencil cave	10	900
Big Lime	80	980
Sand	15	995
Red rock	5	1000
Big Injun sand, very hard and close	110	1110
Squaw sand	34	1144
Unrecorded	200	1344
Slate and lime	176	1520
Fifty-foot sand	20	1540
Slate and shells	20	1560
Thirty-foot sand	40	1600
Slate and shells	30	1630
Gordon Stray sand	15	1645
Red rock and shells	55	1700
Gordon sand	14	1714
Red rock	296	2010
White shale	45	2055
Bayard sand	2	2057

	Thickness. Feet.	Total. Feet.
Red rock	48	2105
White shale to bottom	242	2347

10" casing, 220'; 8¼" casing, 750'.

The above well starts near the horizon of the Brush Creek coal.

Edwin Nuzum No. 2504 Well Record (688A)

Union district, 0.8 mile northwest of Hammond. Authority, Hope Natural Gas Company. Completed June 21, 1912.

	Thickness. Feet.	Total. Feet.
Unrecorded	25	25
Sand	90	115
Unrecorded	37	152
Coal, (Upper Freeport?)	3	155
Unrecorded	70	225
Coal, (Lower Freeport?)	5	230
Unrecorded	30	260
Sand, ("Gas") (steel line measurement, 275')	30	290
Unrecorded	60	350
Sand, (II Cow Run)	90	440
Unrecorded	10	450
Salt sand	50	500
Unrecorded	6	506
Sand, salt	84	590
Unrecorded	75	665
Salt sand	85	750
Unrecorded (water, 775')	100	850
Little Lime	10	860
Pencil cave	18	878
Big Lime (steel line measurement, 916')	114	992
Big Injun sand	113	1105
Unrecorded	4	1109
Squaw sand	23	1132
Unrecorded	152	1284
Sand, (Berea)	16	1300
Unrecorded	220	1520
Fifty-foot sand	70	1590
Unrecorded	253	1843
Gordon sand (steel line measurement, 1849')	9	1852
Unrecorded	57	1909
Fourth sand	11	1920
Unrecorded	95	2015
Sand, (Fifth)	13	2028
Unrecorded	496	2524
Sand (gas, 2524') (Speechley?)	6	2530
Unrecorded to bottom (gas show, 2584')	396	2926

10" casing, 279'; 8¼" casing, 923'; 6⅝" casing, 1861'.

Pressure test:

Ten-tenths water in 1" opening, equivalent to 37,300 cu. ft. daily.

The above well should start about 500 feet below the horizon of the Pittsburgh coal, according to the Pittsburgh coal—Big Injun sand intervals in the two preceding wells.

Prospective Oil and Gas Areas, Winfield and Union Districts.—As mentioned at the beginnng of the discussion of these two districts the prospects of opening a pool of either oil or gas therein are not very bright. However, there occurs a pronounced structural terrace along the line between Winfield and Union immediately to the northwest of the axis of the Chestnut Ridge anticline, on which it is barely possible that a pool of these hydro-carbons may rest in the Big Injun and deeper sands. A well southward from Samaria near the road fork on the head of Long run, or another three-fourths mile southward from the mouth of Dunham Lick on Prickett creek would test the matter thoroughly. As mentioned under the account of the oil and gas development in Union, Morgan and Clinton districts, Monongalia, the folding has been so intense along the crest of the Chestnut Ridge arch that the oil and gas may have long ago escaped into the air through the resulting cracks and minor fissures.

Grant District.

Grant district, Marion, occupies that portion of the county between the West Fork and Tygart Valley rivers, so that most of its area lies along the western slope of the Chestnut Ridge anticline. The Mooresville arch traverses in a north and south direction the western point of the district, where this fold is finally dying out on the steeper western slope of the first mentioned anticline. In this portion of the district several paying gas wells have been drilled. The two following records are from wells therein.

J. Lee Bice No. 1 Well Record (678).

Grant district, 0.9 mile west of Eldora. Authority, Hog Lick Oil & Gas Company.

(Elevation, 1020′ B-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	440	440
Little Dunkard sand	50	490
Unrecorded	20	510

	Thickness. Feet.	Total. Feet.
Big Dunkard sand	37	547
Unrecorded	24	571
Sand, ("Gas")	48	618
Unrecorded	22	640
Gas sand	23	663
Unrecorded	145	808
First Salt sand	69	877
Unrecorded	53	930
Second Salt sand	160	1090
Unrecorded	256	1346
Little Lime	25	1371
Unrecorded	40	1411
Big Lime	72	1483
Big Injun sand	136	1619
Unrecorded	8	1627
Squaw sand	24	1651
Unrecorded	64	1715
Berea Grit	133	1848
Unrecorded	159	2007
Fifty-foot sand (little show oil and gas, 2010')	46	2053
Unrecorded	47	2100
Thirty-foot sand	37	2137
Unrecorded	9	2146
Gordon Stray sand	51	2197
Unrecorded	9	2206
Gordon sand	14	2220
Unrecorded	172	2392
Fifth sand	6	2398
Unrecorded	131	2529
Bayard sand	18	2547
Unrecorded to bottom	22	2569

10" casing, 242'; 6⅝" casing, 1420'.

The above well record starts close the horizon of the Pittsburgh coal.

Harriet Frum No. 1 Well Record (680).

Grant district, 0.6 mile N 20° W of Boothsville. Authority, Grant Development Company.

(Elevation, 995' B-A.T.)	Thickness. Feet.	Total. Feet.
Conductor	8	8
Unrecorded (water, 60' and 85')	362	370
Big Dunkard sand	80	450
Unrecorded	150	600
First Gas sand (water)	40	640
Coal, Lower Kittanning	8	648
Unrecorded	42	690
Second Gas sand (gas, 700')	50	740
Unrecorded	40	780
Salt sand (water, 800'; gas, 806')	33	813
Unrecorded	2	815
Second Salt sand	115	930

	Thickness. Feet.	Total. Feet.
Unrecorded	60	990
Red rock	195	1185
Unrecorded	115	1300
Big Lime	67	1367
Big Injun sand (gas)	93	1460
Unrecorded	10	1470
Big Injun sand, (gas, 1477′)	27	1497
Unrecorded	106	1603
Squaw sand (oil show, 1604′)	12	1615
Unrecorded	258	1873
Gantz? sand and unrecorded	19	1892
Fifty-foot sand (gas show, 1911′)	137	2029
Unrecorded	22	2051
Gordon Stray sand	10	2061
Unrecorded	19	2080
Gordon sand	15	2095
Unrecorded	73	2168
Sand	10	2178
Unrecorded	145	2323
Fifth sand and unrecorded	64	2387
Bayard sand to bottom	47	2434

10″ casing, 142′; 8¼″ casing, 845′; 6⅝″ casing, 1329′.

The above well starts about 130 feet below the Pittsburgh coal.

Prospective Oil and Gas Areas, Grant District.—The eastern portion of Grant district, Marion county, like Winfield and Union, does not look so promising for either oil or gas in paying quantity for the same reasons as given for the latter districts. However, there are a few small areas that would warrant the drilling of more wells, both from the standpoint of structure and development. (1) That territory for two miles northeasward from the Marion-Taylor county line between the 1300 and 1425-foot contours of Pittsburgh coal as outlined on Map II appears good for Fifty-foot sand gas in view of the good Holt gasser (690) in the edge of Taylor to the southwest; (2) that west and southwest of Chiefton, for gas in the Big Injun and deeper sands; and (3) that, immediately along the crest of the Mooresville anticline for gas at the same horizons.

Summarized Record of

Map No.	NAME OF WELL	Location—District	OWNER	Elevation A. T.
689	Geo. Tucker No. 1	Booths Creek..	Colfax	1070B
690	J. F. Holt No. 1	Booths Creek..	Dugan et al.	980B
690A	R. L. Reed No. 1	Booths Creek..	Hope	....
691	R. L. Reed No. 1	Booths Creek..	South Penn	954L
691A	Riley-Weathers No. 1	Booths Creek..	———	....
692	G. Wm. Harr No. 1	Booths Creek..	———	980B
692A	Geo. Martin No. 1	Booths Creek..	Steele	1030B
693	John A. Russell No. 1	Booths Creek..	Miller et al.	1165B
693A	Wilson No. 1	Booths Creek..	———	....
694	Samuel Hibbs No. 1	Booths Creek..	South Penn	1210B
694A	James Riley No. 1	Booths Creek..	Home	....
695	Kimball No. 1	Booths Creek..	———	890B
696	John Tolles No. 1	Booths Creek..	Murphy	975L
697	Martha Tucker No. 1	Booths Creek..	P. McGrady	1080B
698	C. H. Curry No. 1	Booths Creek..	Hope	1150B
699	John Williamson No. 1	Booths Creek..	Taylor	1120B
700	Harrison Jones Heirs No. 1	Booths Creek..	Comet O. & G.	1205B
700A	Harry Swindler No. 1	Booths Creek..	Comet O. & G.	....
701	Harrison Jones Heirs No. 2	Booths Creek..	Home	1272L
701A	John T. Whitescarver No. 1	Booths Creek..	Comet O. & G.	....
702	C. E. Dunham No. 1	Booths Creek..	Phila.	1268L
702A	Brown Heirs No. 1	Booths Creek..	Comet O. & G.	....
703	Hugh Evans No. 2	Booths Creek..	Phila	1101L
704	Geo. Gawthrop No. 1	Booths Creek..	Phila.	1115B
704A	T. A. Gawthrop No. 1	Booths Creek..	Comet O. & G.	....
705	Geo. W. Reynolds No. 1	Booths Creek..	Phila	1180B
706	R. B. Coll No. 1	Booths Creek..	Phila.	1290B
707	U. S. Morrow No. 2251	Booths Creek..	Phila.	1270B
708	Lizzie E. Morrow No. 2250	Booths Creek..	Phila.	1328L
708A	Bartlett No. 1	Booths Creek..	Hope	....
709	Dan Copeland No. 1	Flemington	McGraw	1372B
710	Martin L. Shields No. 1	Flemington	Flemington	1215B
711	John B. Cather No. 1	Flemington	Flemington	1140B
712	Mrs. H. P. Davidson No. 1	Flemington	Mandell	1105B
713	Pittsvein Coal Co. No. 1	Flemington	———	1183L
714	Hugh Evans No. 1	Courthouse	Phila.	1136L
715	Sarah E. Whitescarver No. 1	Courthouse	J. T. McGraw	1115B
715A	Clare F. Shafer No. 1	Courthouse	Home	1240B
716	Clee Woodford No. 1	Courthouse	John Holt	980B
717	M. Rector coal test	Courthouse	———	984L
718	M. Rector No. 1	Courthouse	Rector	985L
719	A. J. Bartlett coal test	Courthouse	Wilgus & Grant	1006L
720	Idell DeLillier No. 1	Lyon (Preston).	Great Elk	1190B
721	Hamilton Coal Co. coal test.	Lyon (Preston).	Hamilton	1155B
722	Newton Grimes No. 1	Knottsville	———	1110B
723	E. H. Bennett coal test No. 4.	Knottsville	Mohawk	1008L
724	E. H. Bennett coal test No. 2.	Knottsville	Mohawk	1022L
725	E. E. McDaniel coal test No. 3	Knottsville	Mohawk	1105B
726	Lucinda McDaniel Hrs. No. 1.	Knottsville	Hardin	998L
727	Daniel Sinclair No. 1	Reno (Preston).	J. G. Wolf	1315B
728	Jas. M. Hamilton coal test	Reno (Preston).	J. M. Guffey	1314L
729	Jas. M. Hamilton coal test	Reno (Preston).	J. Sliney	1325L
730	Jas. M. Hamilton coal test	Cove (Barbour).	J. M. Guffey	1309L

Wells in Taylor County.

PITTSBURGH COAL		Big Injun Sand (top)	Thirty Foot Sand (top)	Gordon Sand (top)	Fourth Sand (top)	Fifth Sand (top)	Total Depth	PRODUCING SAND AND REMARKS	Map No.
Depth (top)	Thickness								
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	689
.....	.....	1132	.....	.....	.....	.....	1667	50-ft. & B. I. gas	690
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. gas	690A
.....	.....	1280	1845	.....	.....	2162	2400	50-ft. gas	691
.....	.....	.....	.....	.....	.....	.....	.....	———	691A
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. gas show	692
.....	.....	.....	.....	.....	.....	.....	(1300)	B. I. gas	692A
.....	.....	1365	1980	.....	.....	.....	2570	"Gas" and 6th gas show.	693
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. gas	693A
.....	.....	.....	.....	.....	.....	.....	.....	50-ft. oil show	694
.....	.....	1195	.....	.....	.....	2088	2300	5th and 6th gas	694A
.....	.....	.....	.....	.....	.....	.....	500?	6th gas	695
.....	.....	.....	.....	.....	.....	.....	.....	Gas, light show	696
.....	.....	812	1425	1530	.....	.....	2420	B. Lm. gas	697
.....	.....	925	.....	.....	.....	1955	2300	———	698
.....	.....	.....	.....	.....	.....	.....	2200	———	699
.....	.....	1275	.....	2080	.....	2150	2500	B. I. gas	700
.....	.....	1444	1955	2100	.....	2307	2492	B. I. gas, light	700A
.....	.....	1525	.....	.....	.....	.....	1720	B. I. gas	701
.....	.....	.....	.....	.....	.....	.....	.....	B. I. gas	701A
.....	.....	1415	1995	2073	2130	2319	2462	B. I. gas	702
.....	.....	1235	.....	1886	.....	2110	2303	———	702A
.....	.....	1225	.....	1900	2000	2095	2124	5th gas	703
.....	.....	1220	.....	.....	.....	2066	2123	5th gas	704
.....	.....	1265	.....	.....	.....	2097	2145	5th gas	704A
.....	.....	1295	.....	1946	.....	2145	2650	5th gas	705
.....	.....	1315	.....	.....	.....	2190	2234	5th gas	706
.....	.....	1275	.....	.....	.....	2170	2250	50-ft. gas	707
.....	.....	1260	.....	.....	.....	.....	1733	50-ft. gas	708
.....	.....	1285	.....	.....	.....	.....	.....	B. I. gas	708A
.....	.....	1445	.....	.....	.....	2300	2549	B. I. gas	709
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	710
.....	.....	1260	.....	.....	.....	2122	2239	50-ft. gas	711
.....	.....	1360	.....	.....	.....	2128	2400	B. I. & 5th gas, light...	712
.....	.....	1575	2140	2224	.....	.....	3019½	B. I. gas show	713
.....	.....	1333	.....	.....	2116	2206	2680	5th gas	714
.....	.....	.....	.....	.....	.....	.....	(2476)	B. I. & 5th gas show....	715
.....	.....	1572	2175	2128	.....	2435	2597	Dry hole	715A
.....	.....	.....	.....	.....	.....	.....	.....	Gas show	716
.....	.....	.....	.....	.....	.....	.....	.....	Coal test	717
.....	.....	(600)	.....	.....	.....	.....	2515	B. I. oil show	718
.....	.....	.....	.....	.....	.....	.....	456	Coal test	719
.....	.....	.....	.....	.....	.....	.....	.....	Salt oil & gas show	720
.....	.....	.....	.....	.....	.....	.....	225	Coal test	721
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	722
.....	.....	.....	.....	.....	.....	.....	.....	Coal test	723
.....	.....	.....	.....	.....	.....	.....	140	Coal test	724
.....	.....	.....	.....	.....	.....	.....	144	Coal test	725
.....	.....	970	1370	.....	.....	.....	2502	Dry hole	726
.....	.....	.....	.....	.....	.....	.....	.....	Dry hole	727
.....	.....	.....	.....	.....	.....	.....	.....	Coal test	728
.....	.....	.....	.....	.....	.....	.....	.....	Coal test	729
.....	.....	.....	.....	.....	.....	.....	.....	Coal test	730

The accompanying table contains the abbreviated logs of 41 wells in Taylor county as well as levels on most of the same, along with elevations and data on other wells the records of which could not be obtained. The borings are numbered from 689 to 730 inclusive and grouped as in Monongalia and Marion by magisterial districts, the serial number in each instance corresponding to the number of the same well on Map II. For further particulars the reader is referred to the explanations directly following the Monongalia table of well records. Under the column headed "Owner" the following abbreviations are used:

Colfax O. & G.	Colfax Oil & Gas Company.
Comet O. & G.	Comet Oil & Gas Company.
Flemington	Flemington Oil & Gas Company.
Great Elk	Great Elk Oil & Gas Company.
Hamilton	Hamilton Coal Company.
Hardin	George and Andrew Hardin.
Home	Home Drilling Company.
Hope	Hope Natural Gas Company.
Mandell	Mandell Oil & Gas Company.
Mohawk	Mohawk Smokeless Coal Company.
Philadelphia	Philadelphia Company.
South Penn	South Penn Oil Company.
Taylor	Taylor County Company.

For explanations of column headings in the accompanying list for Taylor, the reader is referred to the same immediately following the tables for Monongalia and Marion counties.

For the reasons given on the pages immediately following the Monongalia table of well records the complete logs of a number of borings in Taylor county along with a discussion of the structure and development will now be given. As heretofore, the serial number is published, not only in the foregoing table, but along with the heading in parenthesis when the complete log is given, as well as on Map II.

Booths Creek District.

Booths Creek district occupies the northwest portion of Taylor county, and its area is almost bisected in a northeast-southwest direction by the axis of the great Chestnut Ridge anticline. On entering Taylor from Marion county this fold flattens down to the southwest, having lost much of its prominence of eastern Monongalia. No paying oil wells have yet been discovered in the county, but in this district there occur several paying gas wells along the crest and a short distance down the slopes of the last mentioned arch in the rocks. The principal producing sands therein are the Big Injun, Fifty-foot and Fifth. The development will now be discussed from north to south across the district.

In the northwest corner of the district one-half dozen wells have been drilled, only one of which—**J. F. Holt No. 1 (690)**—has proved a good gasser. This well was completed soon after the opening of the Shinnston oil pool of eastern Harrison county, and it has an initial volume of 1.3 million cubic feet daily, with a rock pressure of 220 pounds to the square inch. When first shut in this well would give its rock pressure in less than one minute. A light flow of gas was struck in the Big Injun sand.

The detailed log of the **R. L. Reed No. 1 well (691)**, located 0.2 mile southwest of Boothsville, is published on pages 338-339 of Vol. I(A) of the State Survey reports. This well starts near the crop of the Elk Lick limestone, about 250 feet below the Pittsburgh coal horizon; hence, the coal at 435 feet represents the Upper Kittanning instead of the Upper Freeport as given on the pages mentioned. A light show of gas was encountered in the Fifty-foot.

The following is the record of practically a dry hole located 0.9 mile southwest of the Holt well (690):

John A. Russell No. 1 Well Record (693).

Booths Creek district, 1 mile south of Boothsville. Authority Geo. E. Miller & Company. Completed Dec. 28, 1910.

(Elevation, 1165′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	32	32
Unrecorded	418	450

	Thickness. Feet.	Total. Feet.
Burning Springs sand	20	470
Unrecorded	70	540
Coal, (Upper Kittanning)	3	543
Unrecorded	2	545
Gas sand (gas, 545')	25	570
Unrecorded	720	1290
Big Lime	75	1365
Big Injun sand	110	1475
Unrecorded	940	2415
Sand, (Fifth)	30	2445
Slate	20	2465
Sand, (Bayard) (light show of gas, 2475')	10	2475
Slate and shale to bottom	95	2570

The following is the record of a well in the northeast corner of Booths Creek district, in which sufficient gas was encountered in the Big Lime to furnish domestic fuel for three families. The well mouth is about 215 feet below the horizon of the Pittsburgh coal:

Martha Tucker No. 1 Well Record (697).

Booth's Creek district, 1 mile south 10° west of Valley Falls. Authority, P. H. McGrady.

(Elevation, 1080' B-A. T.)	Thickness. Feet.	Total Feet.
Conductor	8	8
Unrecorded	8	16
Coal, (Upper Kittanning)	4	20
Unrecorded (water, 40')	190	210
Coal, (Tionesta)	9	219
Unrecorded	16	235
Coal, (Upper Mercer)	7	242
Unrecorded	3	245
Sand and unrecorded	70	315
Slate and unrecorded	45	360
Gas sand	30	390
Unrecorded	160	550
Salt sand (gas, 805') and unrecorded	272	812
Sand and lime (Big Injun sand)	128	940
Unrecorded	380	1320
Sand and slate	25	1345
Fifty-foot sand	50	1395
Unrecorded	30	1425
Thirty-foot sand	15	1440
Unrecorded	70	1510
Gordon Stray sand	70	1580
Unrecorded	50	1630
Gordon sand	5	1635
Unrecorded to bottom	785	2420

10" casing, 150'; 8" casing, 740'.

Along the southeast border of Booths Creek district a very prolific gas pool was opened a few years ago by Hon John T. McGraw of Grafton. The Big Injun, Fifty-foot and Fifth are the main producing sands. The eleven following records from wells in this field, most of which were furnished the Survey by Patrick McGrady of Grafton, give valuable data as to the thickness and depth of probable minable coals, and the volume and rock pressure of the gas encountered:

Harrison Jones Heirs No. 1 Well Record (700).

Booth's Creek district, 1.1 miles northwest of Pruntytown. Authority, Comet Oil & Gas Company.

(Elevation, 1205' B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded	4	20
Hard sand (water, 30')	30	50
Unrecorded	90	140
Sand (water, 155')	20	160
Unrecorded	125	285
Coal, (Upper Freeport)	3	288
Unrecorded	52	340
Sand, ("Gas")	45	385
Coal, (Upper Kittanning)	7	392
Unrecorded	63	455
Coal, (Lower Kittanning)	5	460
Unrecorded	70	530
Coal, (Upper Mercer)	9	539
Unrecorded	16	555
Coal, (Lower Mercer)	8	563
Unrecorded	12	575
Sand	25	600
Unrecorded	80	680
Salt sand	35	715
Unrecorded	12	727
Salt sand	163	890
Unrecorded	60	950
Sand	100	1050
Little Lime	100	1150
Unrecorded	60	1210
Big Lime	65	1275
Big Injun sand (gas)	75	1350
Unrecorded	50	1400
Squaw sand	135	1535
Unrecorded	87	1622
Berea Grit	38	1660
Unrecorded	75	1735
Fifty-foot sand	20	1755
Unrecorded	165	1920
Gordon Stray sand	8	1928
Unrecorded	152	2080

	Thickness. Feet.	Total. Feet.
Sand, (Fourth)	9	2089
Unrecorded	61	2150
Fifth sand	35	2185
Unrecorded	33	2218
Bayard sand	20	2238
Unrecorded to bottom	262	2500

10" casing, 165'; 6⅝" casing, 1242'.
Dry hole.

The above well starts about 275 feet below the Pittsburgh coal horizon.

Henry Swindler No. 1 Well Record (700A).

Booths Creek district, 1.1 miles northwest of Pruntytown. Authority, Comet Oil & Gas Company.

	Thickness. Feet.	Total. Feet.
Unrecorded (water, 30')	140	140
Sand	20	160
Unrecorded	290	450
Coal, (Upper Freeport)	10	460
Unrecorded	45	505
Sand	15	520
Unrecorded	68	588
Coal, (Upper Kittanning)	6	594
Unrecorded	88	682
Coal, (Lower Kittanning)	12	694
Unrecorded	32	726
Sand (water, 810')	99	825
Coal, (Upper Mercer)	9	834
Unrecorded	526	1360
Big Lime	84	1444
Big Injun sand (gas, 1454')	86	1530
Unrecorded	245	1775
Berea Grit	15	1790
Unrecorded	110	1900
Fifty-foot sand	40	1940
Unrecorded	15	1955
Thirty-foot sand	20	1975
Unrecorded	125	2100
Gordon sand	5	2105
Unrecorded	202	2307
Fifth sand	48	2355
Unrecorded (Bayard sand broken up) to bottom	137	2492

10" casing, 150'; 6" casing, 1457'.
"25000 to 30000 cu. ft. of gas daily show in Big Injun."

The above well record starts about 100 feet below the Pittsburgh coal.

Harrison Jones Heirs No. 2 Well Record (701).

Booths Creek district, 0.5 mile northwest of Pruntytown. Authority, Home Oil & Gas Company.

(Elevation, 1272' L-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	530	530
Coal, (Upper Freeport)	5	535
Unrecorded	105	640
Coal, Upper Kittanning)	5	645
Unrecorded	825	1470
Big Lime	55	1525
Big Injun sand (little gas, 1533')	115	1640
Unrecorded to bottom	80	1720

"Abandoned as dry hole."

The above well starts 54 feet by hand-level below the Pittsburgh coal, according to Reger.

The **Harrison Jones No. 2 Well (701A)**, located 0.5 mile westward from Pruntytown, had an initial gas production of 3/4 million cubic feet from the Big Injun, with a rock pressure of 450 pounds per square inch.

C. E. Dunham No. 1 Well Record (702).

Booths Creek district, 1.5 miles west of Pruntytown. Authority, Philadelphia Company.

(Elevation, 1268' L-A. T.)	Thickness. Feet.	Total. Feet.
Soil, slate, lime, sand, etc	87	87
Lime (water, 90')	15	102
Red rock	20	122
Slate	30	152
Lime (water, 180')	38	190
Shale	13	203
Coal, (Bakerstown)	4	207
Shale	10	217
Slate	25	242
Red rock	12	254
Lime and slate	30	284
Lime	7	291
Slate	25	316
Red rock	10	326
Lime	14	340
Red rock	8	348
Lime and slate	61	409
Shale	20	429
Slate and lime	47	476
Sand ("Gas")	39	515
Slate and lime	90	605
Coal, (Lower Kittanning)	2	607
Lime and slate	31	638
Coal, (Clarion)	7	645

	Thickness. Feet.	Total. Feet.
Lime	15	660
Shale and some coal (Brookville)	18	678
Slate and lime	64	742
Slate and shells	28	770
Sand	15	785
Coal, (Upper Mercer)	2	787
Sand, salt	35	822
Slate and unrecorded	510	1332
Big Lime (hard)	83	1415
Big Injun sand	88	1503
Slate and lime	25	1528
Slate and shells	127	1755
Lime and slate	65	1820
Sand	10	1830
Slate	42	1872
Fifty-foot sand	90	1962
Slate	33	1995
Thirty-foot sand	20	2015
Slate and lime shells	40	2055
Gordon Stray sand	12	2067
Slate	6	2073
Gordon sand	5	2078
Red rock	15	2093
Lime	8	2101
Red rock	29	2130
Fourth sand (limy)	40	2170
Red rock	45	2215
Sand	9	2224
Red rock	43	2267
Sand	5	2272
Red rock	6	2278
Sand, brown	4	2282
Red rock and shells	37	2319
Fifth sand, brown (gas, 2324')	15	2334
Red rock	44	2378
Bayard sand	15	2393
Slate	12	2405
Lime	45	2450
Red rock	12	2462

10" casing, 285'; 8" casing, 944'; 6⅝" casing, 1346'; 3" tubing, 1892'.

The above well starts about 200 feet below the Pittsburgh coal horizon. It had an initial gas production from the Fifth sand of 150,000 cubic feet daily natural, but after being shot made 1,500,000 cu. ft. daily, with a rock pressure of about 675 lbs., according to Patrick McGrady.

Brown Heirs No. 1 Well Record (702A).

Booths Creek district, 1.6 miles west of Pruntytown. Authority, Comet Oil & Gas Company.

	Thickness. Feet.	Total. Feet.
Unrecorded (water, 165')	270	270
Little Dunkard? sand (Big Dunkard)	40	310
Unrecorded	90	400
Sand, ("Gas")	40	440
Unrecorded	28	468
Coal, (Lower Kittanning)	8	476
Unrecorded	32	508
Coal, (Clarion)	4	512
Unrecorded	33	545
Coal, (Brookville)	7	552
Unrecorded	23	575
Sand	5	580
Unrecorded	5	585
Coal, (Upper Mercer)	3	588
Unrecorded	7	595
Sand	12	607
Coal, (Lower Mercer)	6	613
Sand	55	668
Unrecorded	487	1155
Big Lime	80	1235
Big Injun sand	132	1367
Unrecorded	743	2110
Fifth sand (little gas, 2130')	35	2145
Unrecorded	65	2210
Bayard sand	40	2250
Unrecorded to bottom	53	2303

10" casing, 190'; 8" casing, 661'; 6⅝" casing, 1260'.
Dry hole. Starts about 315' below Pittsburgh coal.

Hugh Evans No. 2 Well Record (703)

Booths Creek district, 2 miles S 75° W of Pruntytown. Authority, Philadelphia Company.

(Elevation, 1101' L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	16	16
Unrecorded (water, 17', 150')	199	215
Coal, (Upper Freeport)	3	218
Unrecorded	3	221
Little Dunkard sand (water, 227')	40	261
Unrecorded	39	300
Big Dunkard sand	40	340
Coal, (Upper Kittanning)	5	345
Unrecorded	130	475
Coal, (Upper Mercer)	6	481
Unrecorded	28	509
Sand, (Salt)	56	565
Unrecorded	65	630
Salt sand (water, 635')	25	655
Unrecorded	495	1150

	Thickness. Feet.	Total. Feet.
Big Lime	75	1225
Big Injun sand	115	1340
Unrecorded	55	1395
Squaw sand	85	1480
Unrecorded	615	2095
Fifth sand (gas, 2100') to bottom	29	2124

10" casing, 261'; 8" casing, 412'; 6⅝" casing, 1180'.

"Rock pressure, 680 lbs. in Fifth sand; initial volume, 1,500,000 cu. ft., natural; 3,000,000 cu. ft. after being shot."

The above well starts about 350 feet below the Pittsburgh coal horizon.

Geo. Gawthrop No. 1 Well Record (704)

Booths Creek district, 2.3 miles S 75° W of Pruntytown. Authority, Philadelphia Company.

(Elevation, 1115' B.A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1220	1220
Big Injun sand	125	1345
Unrecorded	330	1675
Fifty-foot sand	75	1750
Unrecorded	316	2066
Fifth sand (gas, 2074' and 2106') to bottom	57	2123

"Initial volume from Fifth sand, ¾ million cu. ft. natural and 1½ million after being shot."

T. A. Gawthrop No. 1 Well Record (704A).

Booths Creek district, 2 miles southwest of Pruntytown. Authority, Comet Oil and Gas Company. Completed in May, 1913.

	Thickness. Feet.	Total. Feet.
Conductor	25	25
Unrecorded (Water, 25' and 165')	260	285
Sand, Little Dunkard	21	306
Unrecorded	18	324
Coal, (Upper Freeport)	4	328
Unrecorded	142	470
Coal (Lower Kittanning)	4	474
Unrecorded	26	500
Coal (Clarion) (water)	6	506
Unrecorded	4	510
Sand	25	535
Unrecorded	45	580
Coal (Upper Mercer)	6	586
Unrecorded	49	635
Sand (Salt) (water, 690')	129	864
Unrecorded	306	1170
Big Lime	95	1265
Big Injun sand	115	1380

	Thickness. Feet.	Total. Feet.
Unrecorded	315	1695
Sand, Fifty-foot	70	1765
Unrecorded	332	2097
Sand, Fifth (Gas, 2098′, 2107′, 2110′)	46	2143
Unrecorded to bottom	2	2145

This well made about 1,500,000 cu. ft. of gas daily, with a rock pressure of 700 pounds.

Geo. W. Reynolds No. 1 Well Record (705).

Booths Creek district, 2 miles west of Meadland. Authority, Philadelphia Company.

(Elevation, 1180′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	528	528
Coal, (Lower Kittanning)	10	538
Unrecorded	22	560
Coal, (Clarion)	10	570
Unrecorded	2	572
Sand, (II Cow Run)	58	630
Unrecorded	23	653
Coal, (Upper Mercer)	10	663
Unrecorded	32	695
Salt sand (water, 725′)	235	930
Unrecorded	280	1210
Big Lime	85	1295
Big Injun sand	95	1390
Unrecorded	70	1460
Squaw sand	90	1555
Unrecorded	595	2145
Fifth sand (gas, 2150′)	45	2190
Unrecorded	30	2220
Sand	45	2265
Unrecorded	15	2280
Bayard sand	95	2375
Unrecorded to bottom	275	2650

10″ casing, 190′; 8″ casing, 930′; 6⅝″ casing, 1460′.

"400,000 cu. ft. natural, and 800,000 cu. ft. after shot in Fifth sand."

The above well record starts about 270 feet below the Pittsburgh coal.

R. B. Gall No. 1 Well Record (706).

Booths Creek district, 1.1 miles S 80° E of Meadland. Authority, Philadelphia Company.

(Elevation, 1290′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1315	1315
Big Injun sand	85	1400

	Thickness. Feet.	Total. Feet.
Unrecorded	368	1768
Fifty-foot sand	107	1875
Unrecorded	315	2190
Fifth sand (gas, 2200)	35	2225
Unrecorded to bottom	9	2234

"¼ million cu. ft. daily natural, and ½ million after shot, but later fell back to ¼ million daily from Fifth sand."

U. S. Morrow No. 2251 Well Record (707).

Booths Creek district, 1 mile east of Meadland. Authority, Philadelphia Company.

(Elevation, 1270′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	1260	1260
Big Injun sand and unrecorded	455	1715
Fifty-foot sand (gas, 1720′) and unrecorded to bottom	18	1733

"Initial gas volume from Fifty-foot sand, 3,000,000 cu. ft. daily."

Lizzie E. Morrow No. 2250 Well Record (708).

Booths Creek district, 0.7 mile east of Meadland. Authority, Philadelphia Company.

(Elevation, 1328′ L-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	8	8
Unrecorded	47	55
Coal, (Harlem)	4	59
Unrecorded (water, 240′)	126	285
Little Dunkard sand	35	320
Unrecorded	36	356
Sand	24	380
Unrecorded	54	434
Big Dunkard sand	46	480
Coal, (Upper Kittanning)	3	483
Unrecorded	712	1195
Big Lime	80	1275
Big Injun sand	84	1359
Unrecorded	372	1731
Fifty-foot sand (gas)	56	1787
Unrecorded	383	2170
Fifth sand	50	2220
Unrecorded to bottom	30	2250

10″ casing, 185′; 3″ tubing, 1358′.

"Initial volume, 250,000 cu. ft., with rock pressure of 480 lbs."

The above well starts on top of the Grafton sandstone or about 275 feet below the Pittsburgh coal horizon.

The **Bartlett No. 1 well (708A)**, located 0.5 mile west of Patton Knob and completed during 1912, is reported as having an initial volume of 1,000,000 cu. ft. of gas daily from the Big Injun, with a rock pressure of 600 lbs. to the sq. inch.

On the crest of the Chestnut Ridge anticline, ¾ mile southwest of McGee, two practically dry holes were drilled on the **C. H. Curry (698)** and **John Williamson (699)** farms to a depth of 2300 and 2200 feet respectively. The wells start over 600 feet below the horizon of the Pittsburgh coal; hence, both penetrated the Bayard sand and probably the horizon of the Elizabeth. A light flow of gas is reported from the Williamson boring.

In January, 1913, the Home Drilling Company of Grafton struck a good gasser in the Bayard sand on the James Riley farm (694A), 0.2 mile northwest of Hepzibah, which, according to O. C. Jefferys, interested in the company, on open flow, gaged 40-tenths inches of mercury from a 2-inch opening, being equivalent to 1,050,000 cubic feet daily. Its rock pressure was 960 pounds to the square inch. The record is as follows:

James Riley No. 1 Well Record (694A).

Booths Creek district, 0.2 mile northwest of Hepzibah. Authority, Home Drilling Co.

	Thickness. Feet.	Total. Feet.
Conductor	6	6
Unrecorded	129	135
Little Dunkard sand (water, 140')	105	240
Unrecorded	15	255
Big Dunkard sand	115	370
Coal (Upper Freeport) (water)	8	378
Unrecorded	37	415
Sand (water)	40	455
Unrecorded	15	470
Coal (Upper Kittanning) (water)	8	478
Unrecorded	7	458
Gas sand	35	520
Unrecorded	45	565
Salt sand (II Cow Run)	115	680
Coal (Tionesta)	6	686
Unrecorded	234	920
Sand (Maxton)	45	965
Unrecorded	135	1100
Big Lime	95	1195
Big Injun sand	75	1270
Unrecorded	20	1290
Squaw sand	10	1300
Unrecorded	310	1610
Fifty-foot sand (broken)	270	1880
Unrecorded	208	2088

	Thickness. Feet.	Total. Feet.
Fifth sand (little gas)	32	2120
Unrecorded	62	2182
Bayard sand (gas)	50	2232
Unrecorded to bottom	68	2300

8 inch casing, 832'; rock pressure 1000 lbs.

During February of this year, the **Wilson No. 1 well (693A)**, 1.6 miles due west, near the Taylor-Harrison line, came in a heavy gasser in the Fifty-foot. Its initial volume is reported at 3,000,000 cubic feet daily.

One-half mile southeastward, the **George Martin No. 1 well (692A)** was drilled about 30 years ago down to the top of the Big Injun, where a flow of gas was encountered and the tools lost. The well was not drilled any deeper and the gas from same was never utilized.

Prospective Oil and Gas Areas, Booths Creek District.—In the writer's judgment no paying oil will ever be opened in this district, owing to the high comparative structural level its area occupies. The last mentioned feature is very much in its favor when gas is considered, and there yet remains a large untested acreage therein that warrants further drilling. (1) That territory on the western slope of the Chestnut Ridge anticline lying between the 1350 and 1500-foot contour of Pittsburgh coal, as outlined on Map II, appears favorable for gas in the Fifty-foot sand; (2) that, lying south of an east and west line through Hepzibah and west of a meridian line through McGee, for gas in one or more of four sands; viz., Big Injun, Fifty-foot, Fifth and Bayard; and (3) that, northwestward from McGee to the dividing ridge on the north side of Turkey run would justify a test through the Fifth and Bayard sands.

Flemington District.

Flemington district occupies the southwest corner of Taylor county, and its entire area lies in the Ligonier synclinal basin. Only a small portion lies on the east side of the axis of the latter fold. Five wells have been drilled for oil and gas within its boundaries, in three of which light gas flows were

encountered. The following records from wells therein give much data of interest:

Dan Copeland No. 1 Well Record (709).

Flemington district, 1.1 miles S E of Meadland. Authority, John T. McGraw. Completed about 1906.

(Elevation, 1372′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	540	540
Coal, (Lower Freeport)	4	544
Unrecorded	56	600
Gas sand	70	670
Coal, (Lower Kittanning)	10	680
Unrecorded	30	710
Sand, (II Cow Run)	20	730
Unrecorded	45	775
Salt sand (water)	175	950
Unrecorded	415	1365
Big Lime	80	1445
Big Injun sand (gas)	80	1525
Slate and shells	235	1760
Grit (Berea)	30	1790
Slate and shells	90	1880
Fifty-foot sand	85	1965
Slate and shells	135	2100
Red rock and shells	200	2300
Sand, (Fifth)	65	2365
Slate and shells	35	2400
Bayard sand	20	2420
Unrecorded	30	2450
Slate to bottom	99	2549

"Pulled casing, but got enough gas to run a family at present, estimated at 10,000 to 15,000 cu. ft. daily from Big Injun."

The above well starts 97′ by hand-level below the Pittsburgh coal, according to Reger.

John B. Cather No. 1 Well Record (711).

Flemington district, 1.9 miles northwest of Flemington. Authority, Flemington Oil & Gas Company.

(Elevation, 1140′ B-A. T.)	Thickness. Feet.	Total. Feet
Unrecorded	420	420
Coal, (Upper Freeport)	4	424
Unrecorded	6	430
Sand	37	467
Unrecorded	35	502
Sand	18	520
Unrecorded	7	527
Coal, (Upper Kittanning)	8	535
Unrecorded	15	550
Sand	15	565

	Thickness. Feet.	Total Feet.
Unrecorded	10	575
Sand	85	660
Coal, (Clarion)	6	666
Unrecorded	2	668
Sand, 11 Cow Run and Salt (water, 700' and 785')	297	965
Unrecorded	120	1085
Maxton sand	30	1115
Unrecorded	130	1245
Little Lime	20	1265
Unrecorded	15	1280
Big Lime	80	1360
Big Injun sand	88	1448
Unrecorded	328	1776
Fifty-foot sand (little gas, 1788')	109	1885
Unrecorded	237	2122
Sand, (Fourth)	7	2129
Unrecorded	93	2222
Sand, (Fifth)	14	2236
Unrecorded to bottom	3	2239

"Initial gas volume, about 150,000 cu. ft. daily from the Fifty-foot sand."

The above well starts about 200 feet below the Pittsburgh coal.

The detailed log of the **Pittsvein Coal Co. No. 1 well (713)**, located ¼ mile north of Flemington, is published on pages 340-342 of Vol 1(A) of the State Survey reports. This well starts 22 feet by hand-level below the Pittsburgh coal. The well was drilled to a depth of 559½ feet below the Bayard sand and only a light flow of gas encountered in the Big Injun.

The detailed log of the **Mrs. H. P. Davidson No. 1 well (712)**, located on Berry run, 1.5 miles northwest of Flemington, is published on pages 339-340 of Vol I(A) of the State Survey reports. The well starts about 220 feet below the Pittsburgh coal, so that the correlations of the coal beds as published in the report mentioned should be modified slightly. Light gas pays were encountered in the Big Injun and Fifth sands.

No information was obtained for the **Martin L. Shields No. 1 well (710)**, located on Left fork of Berry run, 1.5 miles north of Rosemont, except that it was drilled by the Flemington Oil & Gas Company, and starts 165 feet below the Pittsburgh coal, according to Reger.

Prospective Oil and Gas Areas, Flemington District.—As mentioned at the beginning of the discussion of this district, drilling theren has not been of a very encouraging nature to the oil and gas operator. However, there yet remains a large acreage that warrants the drilling of more test wells. (1) That territory in the northwest corner of the district, lying to the west of the dividing ridge on the east side of Jerry run, appears favorable for gas in the Big Injun, Fifth and Bayard sands: (2), that along the main valley of Simpson creek, westward from Rosemont, for gas in the same horizons; and (3) that along the axis of the Ligonier synicline southward from the B. & O. R. R. at Flemington to the Taylor-Barbour county line is favorably located from a structural standpoint for oil in one of the sands below the Big Injun on account of their non-water bearing qualities. However, the risk would be great, since no paying well of either oil or gas has yet been drilled along the axis of this basin to the writer's knowledge to the northeast, either in Pennslvania or West Virginia. It is quite probable that the conditions leading to the genesis of these hydro-carbons never prevailed along the axis of this fold, or if so, the faults and cracks associated with intense folding of mountain regions has permitted the same to escape into the air.

Courthouse District.

Courthouse district, Taylor county, lies immediately south of Booths Creek district, and east of Flemington. Its entire area lies in the Ligonier Basin. By far the greater portion lies on the east side of the axis of this fold. Five wells have been drilled therein for oil and gas, one of which was a gasser in the Fifth sand. The detailed log of this well—the **Hugh Evans No. 1 (714)**, located 1.2 miles southwest of Prunytown—is published on page 338 of Vol. I(A) of the State Survey reports. The well mouth is about 235 feet below the Pittsburgh coal; hence, the coal correlations as given in Vol. I(A) are correct. Its initial gas volume from the Fifth sand was 400,000 cubic feet daily. A light show of gas was encountered in the Stray.

The three following records are from wells in this district.

Sarah E. Whitescarver No. 1 Well Record (715).

Courthouse district, 2.4 miles southwest of Pruntytown. Authority, John T. McGraw.

(Elevation, 1115′ B-A. T.)	Thickness. Feet.	Total. Feet.
Unrecorded	500	500
Coal, (Upper Kittanning)	6	506
Unrecorded	4	510
Sand	30	540
Unrecorded	150	690
Coal, (Upper Mercer)	8	698
Unrecorded	20	718
Coal, (Lower Mercer)	5	723
Unrecorded	62	785
Salt sand (water, 890′)	111	896
Unrecorded	471	1367
Big Lime	85	1452
Big Injun sand (gas, 1462′)	123	1575
Unrecorded	325	1900
Fifty-foot sand	15	1915
Unrecorded	395	2310
Fifth sand (gas show)	30	2340
Unrecorded to bottom	130	2470

10″ casing, 220′.

The above well was abandoned as a dry hole, although gas shows were struck in the Big Injun and Fifth sands. It starts 250 feet below the Pittsburgh coal.

Clare F. Shafer No. 1 Well Record (715A).

Courthouse district, 2.4 miles southwest of Pruntytown. Authority, Home Drilling Company. Completed during 1912.

(Elevation, 1240′ B-A. T.)	Thickness. Feet.	Total. Feet.
Conductor	10	10
Unrecorded (water, 25′)	30	40
Sand	20	60
Unrecorded (water, 150′)	380	440
Coal, (Bakerstown)	2	442
Unrecorded	68	510
Sand (salt water, 520′)	25	535
Unrecorded	90	625
Sand	40	665
Unrecorded	70	735
Coal, (Upper Kittanning)	3	738
Unrecorded	14	752
Sand	41	793
Unrecorded	2	795
Coal, (Lower Kittanning)	3	798
Unrecorded	29	827
Sand, (If Cow Run)	30	857
Unrecorded	18	875
Sand (water, 885′)	10	885

	Thickness. Feet.	Total. Feet.
Coal, (Upper Mercer)	4	889
Unrecorded	66	955
Sand	55	1010
Unrecorded	130	1140
Sand	40	1180
Unrecorded	90	1270
Sand	25	1295
Unrecorded	55	1350
Sand	20	1370
Unrecorded	130	1500
Big Lime	72	1572
Big Injun sand	95	1667
Unrecorded	343	2010
Fifty- foot sand	40	2050
Unrecorded	25	2075
Thirty-foot sand	15	2090
Unrecorded	25	2115
Gordon Stray sand	6	2121
Unrecorded	7	2128
Gordon sand	6	2134
Unrecorded	301	2435
Fifth sand	55	2490
Unrecorded	50	2540
Bayard sand	45	2585
Unrecorded to bottom	12	2597

The above well starts near the horizon of the Pittsburgh coal. It was abandoned as a dry hole.

M. Rector No. 1 Well Record (718).

Courthouse district, 2 miles southwest of Grafton. Authority, E. L. Rector.

(Elevation, 985' L-A.T.)	Thickness. Feet.	Total. Feet.
Unrecorded	196	196
Coal, (Upper Kittanning)	8	204
Unrecorded	92	296
Coal, (Clarion)	11	307
Unrecorded	1293	1600
Big Injun sand (some oil) and unrecorded	600	2200
Trenton rock and unrecorded	315	2515
Gordon? sand (signs of oil)	..	..

Prospective Oil and Gas Territory, Courthouse District.—While the structure is favorable for oil in the deep non-water bearing sands in this district in the vicinity of Wendel, yet the dry hole (715A) on the Clare F. Shafer farm, and another (713), ¼ mile north of Flemington, makes it appear rather doubtful whether there is an oil pool associated with the gas

field to the northwest along the Booths Creek-Courthouse district line; in other words, gas pools often occur without any apparent connection with an oil pool, but it rarely happens that a gas field is not associated with oil producing territory. In the eastern portion of the district the strata rise rapidly eastward on the west slope of the Hiram anticline, furnishing the necessary relief to aid the segregation of oil and gas into commercial pools, but the dry holes northward from Webster and the one at Stonehouse make the presence of these hydrocarbons in paying quantity quite problematical.

Fetterman District.

Fetterman district occupies the northeast corner of Taylor county, hence, almost its entire area lies along the steep southeastern slope of the great Chestnut Ridge anticline. The southeast portion is traversed in a northeast-southwest direction by the axes of the Ligonier syncline and the Hiram anticline. No wells have ever been drilled for oil or gas within its boundaries. Just across the county line in the edge of Preston, 0.5 mile southeast of Irondale, a dry hole (720) was drilled on the Debillier farm by a Baltimore, Md., corporation, in which a showing of oil and gas is reported in the Salt sand. The total depth of the well was not ascertained.

Prospective Oil and Gas Areas, Fetterman District.—The writer is inclined to class that portion of Fetterman district on the north side of the axis of the Ligonier synicline, as outlined on Map II, as quite doubtful or risky territory from an oil and gas standpoint. In the extreme southeastern portion, however, structure is quite favorable for gas along the crest of the comparatively low Hiram anticline.

Knottsville District.

Knottsville district occupies the southeast corner of Taylor county, and its area is traversed in a northeast-southwest direction by the Hiram anticline. By far the greater portion of the district lies on the western slope of this fold. Considerable relief prevails therein since the Pittsburgh coal horizon varies from 1575'A.T., south of Grafton, to over 2000'A.T.,

northeast of Hiram. Only two wells, both of which were dry, have ever been drilled for oil and gas within the boundaries.

The **Newton Grimes No. 1 well (722)**, located near the southeast edge of Grafton and drilled several years ago by a local company, was a dry hole. No information was obtained for the same.

The **Lucinda McDaniel Heirs No. 1 well (726)**, the log of which was published in connection with the Stonehouse section, was drilled to a depth of 2502 feet—3175 feet below the Pittsburgh coal horizon—without getting either oil or gas. A big flow of water was encountered near the middle of the Big Lime, and another flow near the top of the Gantz sand, the latter being an unusual feature for the sands below the Big Injun in the western portion of the State.

Prospective Oil and Gas Territory, Knottsville District.—The two dry holes already mentioned for this district along its western border do not lend encouragement to the oil and gas operator in that region. However, there is a large acreage within its boundaries that appears to be so favored by structure as to warrant the drilling of two or three test wells. (1) That territory immediately south and southwest of Knottsville on the waters of Swamp run appears to be located over a structural terrace on the west slope of the Hiram anticline and for that reason may probably hold an oil pool, but for reasons given under the discussion of Flemington district, the risk on an investment in a test well thereon would be great; and (2) that, along the crest of the Hiram anticline for one-half mile each side of the axis of the fold appears favorable for gas.

CHAPTER XII.

COAL.

The stratigraphic position, structure and character of the coal beds have already been discussed on preceding pages of this report. The purpose of this chapter is to give a more detailed account of the chemical composition and character of the apparent commercial coals, as well as their probable available area in the three counties.

STATISTICS OF COAL PRODUCTION.

In the territory of this report coal mining on a commercial scale has been confined to six beds; viz., Sewickley, Pittsburgh, Upper Freeport, Upper Kittanning, Lower Kittanning and Upper Mercer. As mentioned on preceding pages, all the minable coals lie deep below drainage in the western portions of Monongalia and Marion counties, but in the eastern portions of the same and in Taylor, the Wolf Summit, Indiana and Chestnut Ridge anticlines have all combined to elevate these beds above drainage, rendering them easily accessible to drift or slope openings; hence, all the coal developments therein have been confined largely to these localities.

The following tables are compiled from the Annual Report of John Laing, Chief of the Department of Mines of West Virginia, for the year ending June 30, 1911:

Coal Production of Marion County from 1888 to 1911 inclusive.

Year.	Tons of 2240 lbs.	Year.	Tons of 2240 lbs.
1888	253,675	1901	2,674,553
1889	245,899	1902	3,172,194
1890	406,900	1903	2,668,914
1891	722,594	1904	2,785,350
1892	903,896	1905	3,251,999
1893	958,296	1906	3,629,805
1894	1,186,542	1907	3,619,764
1895	1,198,336	1908	3,440,666
1896	1,219,017	1909	3,733,765
1897	1,368,682	1910	4,210,622
1898	1,639,625	1911	4,084,822
1899	2,392,983		
1900	2,925,907	Total	52,694,806

Coal Production of Monongalia County from 1888 to 1911 inclusive.

Year.	Tons of 2240 lbs.	Year.	Tons of 2240 lbs.
1888	.....	1901	75,589
1889	6,850	1902	130,371
1890	28,000	1903	148,074
1891	46,100	1904	194,540
1892	70,062	1905	178,752
1893	97,905	1906	196,074
1894	62,125	1907	292,596
1895	47,653	1908	271,843
1896	52,080	1909	235,816
1897	31,288	1910	414,992
1898	68,867	1911	464,319
1899	56,793		
1900	82,148	Total	3,252,837

Coal Production of Taylor County from 1888 to 1911 inclusive.

Year.	Tons of 2240 lbs.	Year.	Tons of 2240 lbs.
1888	66,439	1901	383,223
1889	177,901	1902	415,502
1890	68,403	1903	264,524
1891	83,851	1904	234,502
1892	74,000	1905	252,161
1893	68,928	1906	398,563
1894	72,229	1907	416,138
1895	86,536	1908	396,358
1896	43,469	1909	437,633
1897	178,397	1910	583,222
1898	109,532	1911	634,462
1899	249,103		
1900	376,030	Total	6,071,106

Order of Counties in the Production of Coal, 1897-1911.

Counties.	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911
Fayette	1	1	1	1	1	1	2	1	2	2	2	2	2	2	2
McDowell	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1
Marion	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**3**	**4**	**4**	**4**	**4**	**4**	**4**
Kanawha	4	4	4	4	4	4	5	3	4	3	3	3	3	3	3
Mercer	5	5	5	6	6	6	6	6	6	6	6	6	6	7	8
Harrison	9	9	8	7	5	5	4	5	5	5	5	5	5	5	5
Tucker	6	6	7	5	7	7	7	8	8	8	10	10	10	10	10
Mingo	8	8	9	9	9	8	8	7	7	7	7	7	9	9	9
Mineral	7	7	6	8	8	9	11	11	12	13	14	13	11	13	15
Preston	13	11	10	10	10	10	9	10	10	9	9	11	13	11	11
Taylor	**10**	**10**	**11**	**11**	**11**	**11**	**14**	**16**	**16**	**16**	**17**	**17**	**16**	**15**	**14**
Marshall	11	12	12	12	13	16	13	14	14	15	15	18	19	16	18
Randolph	....	....	....	14	14	14	12	13	13	12	13	14	14	14	13
Barbour	19	19	17	18	12	12	10	9	11	11	11	12	12	12	12
Raleigh	16	16	16	19	17	13	15	12	9	10	8	8	8	6	6
Putnam	12	13	13	13	15	15	16	15	15	14	18	16	17	17	17
Ohio	15	15	14	15	16	17	18	19	21	22	21	21	21	20	20
Brooke	17	18	18	20	20	20	23	22	17	17	16	15	15	18	16
Mason	14	14	15	16	18	19	19	20	22	21	22	22	22	22	22
Grant	....	....	....	....	....	....	22	18	19	19	20	20	20	21	21
Logan	....	....	....	....	....	....	....	....	20	18	12	9	7	8	7
Monongalia	**20**	**17**	**19**	**17**	**19**	**18**	**17**	**17**	**18**	**20**	**19**	**19**	**18**	**19**	**19**
Hancock	18	20	20	21	21	21	20	21	24	24	23	25	26	24	27
Clay	....	....	....	....	....	....	....	25	23	23	24	27	30	30	25
Nicholas	....	....	....	....	....	22	24	24	25	25	25	26	27	26	24
Lincoln	....	....	....	....	....	23	21	23	27	26	30	30	25	28	28
Braxton	....	....	....	....	....	....	....	....	....	....	26	23	23	23	23
Wayne	....	....	....	....	....	....	....	....	26	27	29	29	28	29	32
Upshur	....	....	....	....	....	....	....	....	....	28	27	24	24	25	29
Greenbrier	....	....	....	....	....	....	....	....	....	....	28	28	29	32	30
Lewis	....	....	....	....	....	....	....	....	....	....	31	31	32	33	33
Gilmer	....	....	....	....	....	....	....	....	....	....	32	32	31	31	31
Wyoming	....	....	....	....	....	....	....	....	....	....	....	33	34	34	...
Boone	....	....	....	....	....	....	....	....	....	....	....	....	33	27	26

Production of Coal and Coke in Mononga lia County for the Year Ending June 30, 1911.

COMPANY	MINE	PRODUCTION OF COAL (Tons of 2240 lbs.)			DISTRIBUTION OF COAL (Tons of 2240 lbs.)				PRODUCTION OF COKE (Tons of 2000 lbs.)		
		First 6 Months	Second 6 Months	Total Coal Produced for Year	Used in Oporation of Mine	Furnished Local Trade and Tenants	Used in Coke Ovens	Quantity Shipped from Mines	First 6 Months	Second 6 Months	Total for the Year
Consolidation Coal Co....	No. 30	36,592	20,263	56,855	260	176	.....	56,419	.....	.....	.....
Elkins Coal & Coke Co...	Richard No. 1.	55,796	39,583	95,379	1,640	276	71,205	22,258	23,898	24,581	48,479
Elkins Coal & Coke Co...	Elkins No. 3.	.....	7,874	7,874	.....	.....	.....	7,874	.....	.....	.....
Elkins Coal & Coke Co...	Sabraton No. 5	65,299	69,336	134,635	.....	164	.....	134,471	.....	.....	.....
Connellsville Basin Coke Co.	Connellsville Basin	70,077	67,336	137,413	6,000	462	130,951	.....	41,777	39,719	81,496
Great Scott Coal Co.....	Great Scott..	6,620	5,360	11,980	50	4,500	.....	7,430	.....	.....	.....
Antler Coal Co.....	Grant	.....	13,093	13,093	.....	25	.....	13,068	.....	.....	.....
Pittsburgh Steam Coal Co..	Opekiska	3,949	3,141	7,090	42	215	1,537	5,296	.....	960	960
Totals	.....	238,333	225,986	464,319	7,992	5,818	203,693	246,816	65,675	65,260	130,935

Production of Coal and Coke in Marion County for the Year Ending June 30, 1911.

COMPANY	MINE	PRODUCTION OF COAL (Tons of 2240 lbs.)			DISTRIBUTION OF COAL (Tons of 2240 lbs.)				PRODUCTION OF COKE (Tons of 2000 lbs.)		
		First 6 Months	Second 6 Months	Total Coal Produced for Year	Used in Operation of Mine	Furnished Local Trade and Tenants	Used in Coke Ovens	Quantity Shipped from Mines	First 6 Months	Second 6 Months	Total for the Year
Consolidation Coal Co.	No. 22	94,664	58,851	153,515	1,500	2,011		150,004			
Consolidation Coal Co.	No. 24	85,930	54,078	140,008	5,217	722		134,069			
Consolidation Coal Co.	No. 26	147,364	88,894	236,258	8,369	1,960		225,929			
Consolidation Coal Co.	No. 28	60,946	49,053	109,999	1,440	205		108,354			
Consolidation Coal Co.	No. 34	41,173	36,896	78,069	528			77,541			
Consolidation Coal Co.	No. 36	104,401	69,178	173,579		296		173,283			
Consolidation Coal Co.	No. 38	110,228	76,062	186,290	8,260	1,416		176,614			
Consolidation Coal Co.	No. 43	108,087	101,743	209,830	7,200		36,865	165,765	20,825	3,752	24,577
Consolidation Coal Co.	No. 45	47,152	26,532	73,684	2,125	466		71,093			
Consolidation Coal Co.	No. 47	93,975	58,097	152,072	461	131		151,480			
Consolidation Coal Co.	No. 53	82,690	47,589	130,279	480			129,799			
Consolidation Coal Co.	No. 56	111,481	58,763	170,244	4,473	632		165,139			
Consolidation Coal Co.	No. 59	36,646	16,014	52,660	1,248	85		51,327			
Consolidation Coal Co.	No. 63	125,125	109,286	234,411	2,400		24,659	207,352	502	12,157	12,659
Consolidation Coal Co.	No. 67	47,376	28,745	76,121	1,031	451		74,639			
Consolidation Coal Co.	No. 68	79,495	81,583	161,078	980	576		159,522			
Consolidation Coal Co.	Nichol's Farm	567	603	1,170		1,170					
Kilarm Coal & Coke Co.	Kilarm Nos. 1 & 2	13,850	2,175	16,025		117		15,908			
Jamison Coal & Coke Co.	Jamison No. 7	45,143	94,152	139,295	2,592	342		136,361			
Jamison Coal & Coke Co.	Jamison No. 8	172,366	190,375	362,741	1,464	354	8,067	352,856	2,295	3,135	5,430
Jamison Coal & Coke Co.	Jamison No. 9	41,234	77,652	118,886		328		118,558			
Harry B. Coal Co.	Harry B. Nos. 1 & 2.	20,611	23,149	43,760		50		43,710			
Va. & Pittsburgh Coal & Coke Co.	Kingmont	148,276	152,492	300,768	1,700	1,500	4,739	292,829	1,502	1,460	2,962
Four States Coal & Coke Co.	Annabelle	4,403	62,728	67,131	4,500	790		61,841			
Federal Coal & Coke Co.	Federal	142,831	234,940	377,771	15,569	1,613		360,589			
New Central Coal Co.	Stafford	132,362	111,665	245,027	10,587	1,821		232,619			
Pittsburgh Steam Coal Co.	Elizabeth	20,418	8,818	29,236				29,236			
Catawba Coal Co.	Catawba	8,923	6,696	15,619				15,619			
Dakota Coal & Coke Co.	Dakota, Nos. 1 & 2	2,667	11,605	14,272	2,479	431		11,362			
Phillips Coal Co.	Phillips	6,821	8,203	15,024				15,024			
Totals		2,138,205	1,946,617	4,084,822	84,603	17,467	74,330	3,908,422	25,124	20,504	45,628

Production of Coal and Coke in Taylor County for the Year Ending June 30, 1911.

COMPANY	MINE	PRODUCTION OF COAL (Tons of 2240 lbs.)			DISTRIBUTION OF COAL (Tons of 2240 lbs.)				PRODUCTION OF COKE (Tons of 2000 lbs.)		
		First 6 Months	Second 6 Months	Total Coal Produced for Year	Used in Operation of Mine	Furnished Local Trade and Tenants	Used in Coke Ovens	Quantity Shipped from Mines	First 6 Months	Second 6 Months	Total for the Year
Grafton C. & C. Co.	Sandlick	18,850	16,987	35,837	.....	100	.....	35,737	.....	.....	.....
Pittsvein Coal Co.	Flemington	44,917	13,051	57,968	.....	325	.....	57,643	.....	.....	.....
T. B. Davis	T. B. Davis Nos. 1 & 2.	13,902	21,738	35,640	250	99	.....	35,291	.....	.....	.....
McGraw Coal Co.	New York	30,393	15,672	46,065	1,271	176	.....	44,618	.....	.....	.....
Rosemont Coal Co.	Rosemont	100,860	127,059	227,919	655	383	.....	226,881	.....	.....	.....
Maryland Coal Co.	Wendel Nos. 1, 2, 3, 4 & 5	91,591	87,508	179,099	2,617	390	.....	176,092	.....	.....	.....
Winona C. & C. Co.	Winona No. 2.	11,433	5,457	16,890	900	48	4,340	11,602	649	2,244	2,893
Harrison Coal Co.	Harrison	13,515	13,110	26,625	.....	.....	.....	26,625	.....	.....	.....
Sterling Coal Co., Ltd.	Cecil	1,940	6,479	8,419	750	44	.....	7,625	.....	.....	.....
Totals	.....	327,401	307,061	634,462	6,443	1,565	4,340	622,114	649	2,244	2,893

In the territory of this report there are 10 workable coals in addition to 27 other veins which are too thin, impure and irregular to have any economic importance. The probable minable beds in descending order are the Washington in the Dunkard series; the Waynesburg; Sewickley, Redstone and Pittsburgh in the Monongahela; the Upper Freeport, Upper Kittanning, Lower Kittanning and Clarion in the Allegeheny, and the Upper Mercer in the Pottsville.

The chemical analyses and calorific results given for the coals in this report were determined by J. Berghuis-Krak, Assistant Chemist, under the supervision of B. H. Hite, Chief Chemist of the Survey. The same methods of analysis of commercial mines were employed as obtain in the Fuel Testing Department of the United States Geological Survey, the calorific value of coals being expressed in terms of British Thermal Units (B. T. U.), this unit of heat measurement representing the amount of heat required to raise one pound of water one degree Fahrenheit in temperature. In any analysis giving the B. T. U. result, the number of units represents the amount of heat stored up in one pound of coal. In addition to both the proximate and ultimate analysis and calorific tests, the table at the end of this chapter gives the ratio of the total carbon to the oxygen plus ash, the latter being the best ratio yet devised for the classification of coals in order of their relative rank as to heat value.

The apparent coals of the area will now be discussed by series in descending order.

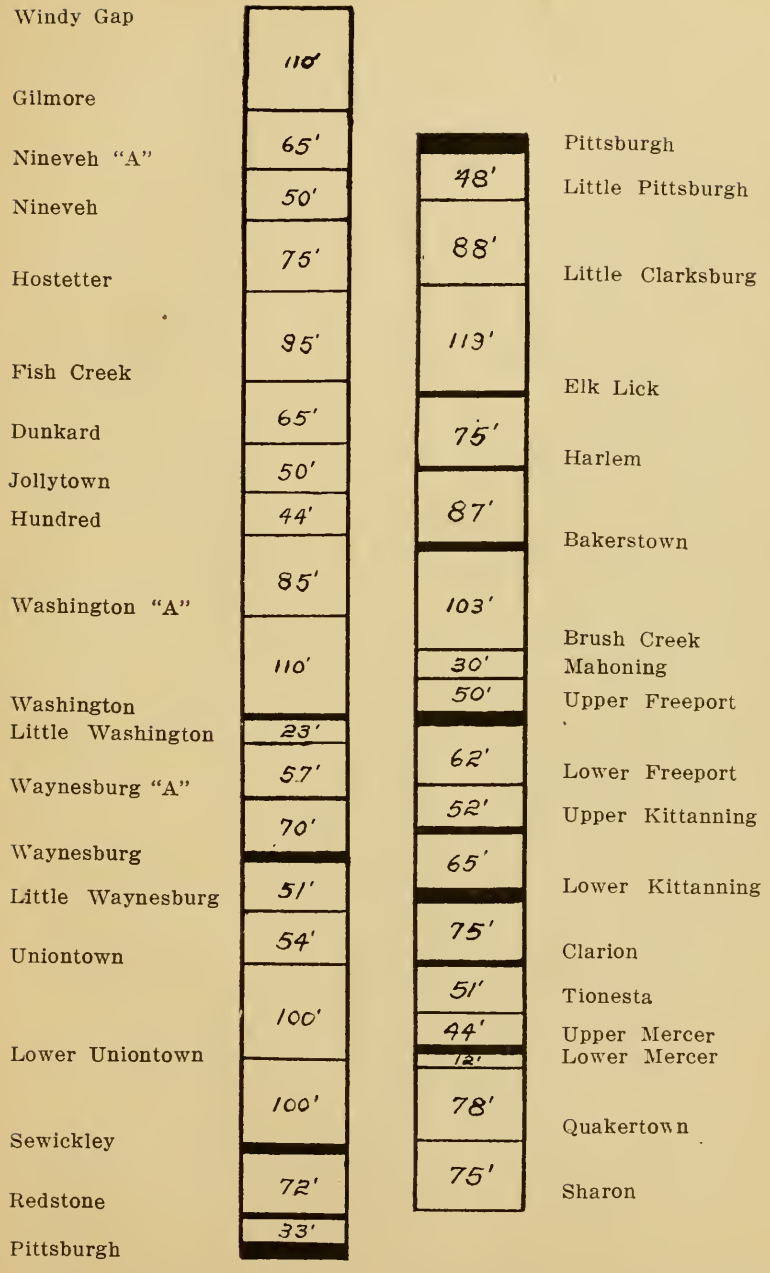

Figure 3.—Diagram showing the relative positions of coal seams.

Figure 1.—Showing area of Washington Coal

MINABLE COALS OF THE DUNKARD SERIES.

The Washington Coal.

The Washington bed appears to be the only coal in the Dunkard series to attain sufficient thickness, purity and regularity to be classed as a minable vein. Its crop is shown by an appropriate symbol on Map II. A detailed description of its thickness, character and distribution is given on pages 201-205.

Quantity of Washington Coal Available.

Owing to the fact that the Washington coal lies deeply buried below drainage in the western portions of Monongalia and Marion counties the only data available to determine its thickness and regularity were the records of wells bored for oil and gas in this region. Unfortunately the drillers, being more interested in the oil sands and their main "key rock," the Pittsburgh coal, quite generally fail to record other coals; hence, even these data are quite meager. The following is a list of wells recording depth and thickness of the Washington bed.

List of Wells Recording Washington Coal.

No. on Map.	NAME OF WELL.	LOCATION.	WASHINGTON COAL.		
			Elevation of Well Mouth. A. T.	Depth Feet.	Thickness Feet.
	Monongalia County:				
27	Sol. Shriver No. 2...	Wadestown, 1.4 m. NE.....	1015B	275	4
53	John Estel Hrs. No. 1	St. Leo, 1 m. N 15° E.....	....	810	3
80	M. J. Garrison No. 1..	Wadestown, 1.2 m. SE.....	1120B	375	2
	Marion County:				
348	L. A. Keenan No. 1..	Glover Gap, 1.9 m. N 30° W...	1135B	460	2
354	A. M. Glover No. 4..	Glover Gap, 0.6 m. NW.....	1160B	440	2
371	Riley Arnett No. 2..	Rymer, 1.7 m. S 85° W.....	1120B	450	4
372	Riley Arnett No. 1..	Rymer, 1.1 m. W.	1055B	350	12
448	A. J. Hayes No. 8....	Rymer, 1.1 m. NE.	1300B	510	10
600	L. D. Martin No. 1..	Downs, 1.2 m. NE.	....	120	..

From the above data and its exposure at crop, together with reports from drillers, it seems quite safe to assume an average thickness of 2 feet spread over the entire area given in the table next below. A careful measurement of its area with planimeter on Map II gives the following results, as determined by Reger:

Available Washington Coal.

Counties by Districts	Sq. Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Monongalia				
Battelle	56.40	36,096	3,144,683,520	125,787,341
Clay	57.04	36,506	3,180,402,720	127,216,109
Cass	7.65	4,896	426,539,520	17,061,581
Grant	6.70	4,288	373,568,560	14,942,742
Totals	127.79	81,786	7,125,194,320	285,007,773
Marion				
Mannington	90.79	58,106	5,062,194,720	202,487,789
Pawpaw	15.65	10,016	872,593,920	34,903,757
Lincoln	24.01	15,366	1,338,685,920	53,547,437
Fairmont	4.18	2,675	231,046,000	9,241,841
Totals	134.63	86,163	7,504,520,560	300,180,824
Totals for Area...	262.42	167,949	14,629,714,880	585,188,597

To arrive at the above results, a weight of 80 pounds to the cubic foot of coal was assumed, or at the rate of 25 cubic feet to the short ton. The latter figures obtain at the Fuel Testing plant of the U. S. Geological Survey for the same amount of Pittsburgh coal.

Owing to the presence in the territory of this report of several thicker, purer and more easily accessible coals, the Washington bed is not marketable at present. When these better coals approach exhaustion, then the poorer grades will no doubt be utilized for both heat and power.

MINABLE COALS OF THE MONONGAHELA SERIES.

Additional Coal Test Records.

After this volume had gone to press, the Survey secured, through the courtesy of George T. Watson, Vice-President and General Manager, and Frank Haas, Consulting Engineer, of the Consolidation Coal Company of Fairmont, the records of eleven coal test borings that were made in Clay, Cass and

Grant districts, Monongalia county. Since these records contain much valuable information on the coals of the Monongahela series, they are published in the following pages. To save space some of the details of strata have been omitted, but the coal formations are given in full.

E. W. Brand Coal Test No. 1 (315).

Grant district, 1 mile N 70° W of Laurel Point. Authority, Consolidation Coal Company.

(Elevation, 1005.29' L-A. T.		Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone and shale		46	11	46	11
Sandstone, gray		35	6	82	5
Slate, black		5	9	88	2
Sandstone, gray (Sewickley)		28	3	116	5
Slate, black		0	4	116	9
Coal 5′ 5″ Slate 0 2 Fire clay 1 9 Coal 0 5	Upper Sewickley	7	9	124	6
Fire clay		4	0	128	6
Slate, black		1	0	129	6
Limestone		16	0	145	6
Fire clay		3	7	149	1
Coal, (Lower Sewickley)		0	1	149	2
Limestone		6	7	155	9
Fire clay		4	7	160	4
Limestone		4	10	165	2
Fire clay		8	0	173	2
Shale, dark, sandy		14	9	187	11
Coal, (Redstone)		0	1	188	0
Limestone		16	0	204	0
Shale, black		1	2	205	2
Bone and coal 2′ 5″ Slate, dark 3 2 Coal 0 2 Slate, black 0 8 Coal 0 9 Slate, dark 0 6 Coal 8 5	Pittsburgh (Elevation of base, 784.04′)	16	1	221	3
Fire clay to bottom		0	11	222	2

J. H. Cole Coal Test No. 2 (292).

Grant district, 1.5 miles S 10° E of Cassville. Authority, Consolidation Coal Company.

(Elevation, 1057.6′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone and shale	43	11	43	11
Slate, black (Uniontown coal)	2	0	45	11
Limestone, shale and thin sandstone	127	5	173	4
Sandstone, (Sewickley)	41	11	215	3
Slate, black	4	0	219	3
Coal, Upper Sewickley (Elevation of base, 932.6′ L-A. T.)	5	10	225	1
Fire clay	6	0	231	1

	Thickness. Ft.	In.	Total. Ft.	In.
Limestone	9	5	240	6
Slate, dark	7	3	247	9
Coal, (Lower Sewickley)	0	2	247	11
Limestone	18	8	266	7
Fire clay	3	0	269	7
Limestone	4	0	273	7
Fire clay	5	0	278	7
Coal, (Redstone)	2	3	280	10
Shale, gray	2	3	283	1
Limestone	12	10	295	11
Slate, dark	3	8	299	7
Coal ....0′ 6″				
Slate, black....2 8				
Coal 0 2				
Slate, dark....1 4	Pittsburgh	14	2	313	9
Coal 0 6	(Elevation of base,				
Slate, black....0 10	743.9′ L-A. T.)				
Coal 8 2					
Limestone to bottom	1	10	315	7

Mankedick Heirs Coal Test No. 3 (267)

Cass district, 0.7 mile east of Cassvile. Authority, Consolidation Coal Company.

(Elevation, 963.05′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone and shale	52	10	52	10
Sandstone, Sewickley	13	0	65	10
Slate, dark	10	6	76	4
Coal, Upper Sewickley (Elevation of base, 882.7′ L-A. T.)	4	0	80	4
Fire clay	4	0	84	4
Limestone	8	0	92	4
Shale, sandy	11	5	103	9
Slate, dark	5	0	108	9
Coal, Lower Sewickley	0	1	108	10
Slate, limestone and fire clay	27	8	136	6
Coal, Redstone	1	10	138	4
Fire clay	1	7	139	11
Limestone	15	3	155	2
Fire clay	3	2	158	4
Coal, bony....1′ 0″				
Slate, black....4 9				
Coal 0 5	Pittsburgh	15	1	173	5
Slate 0 11	(Elevation of base,				
Coal 8 0	789.6′ L-A. T.)				
Fire clay to bottom	2	0	175	5

J. N. Michael Coal Test No. 4 (303).

Grant district, 1.8 miles northeast of Hagans. Authority, Consolidation Coal Company.

(Elevation, 1159.02′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface	4	0	4	0
Shale, sandy	13	0	17	0
Fire clay	30	0	47	0

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Coal ..... 0′ 2″ ⎫				
Slate, soft.... 2 7 ⎬ Waynesburg "A"	4	2	51	2
Coal ..... 1 5 ⎭				
Slate, black.....	0	9	51	11
Fire clay.....	12	0	63	11
Shale, blue.....	12	0	75	11
Fire clay.....	20	0	95	11
Slate, dark	4	7	100	6
Sandstone, (Waynesburg)	16	0	116	6
Slate, black	8	0	124	6
Coal ..... 0′ 6″ ⎫				
Fire clay..... 1 0 ⎪				
Coal ..... 3 11 ⎪				
Slate ..... 0 3 ⎪				
Coal ..... 0 6 ⎪				
Slate ..... 0 3 ⎬ Waynesburg	8	2	132	8
Coal ..... 0 5 ⎪				
Bone coal..... 0 2 ⎪				
Sandstone .... 0 3 ⎪				
Bone ..... 0 2 ⎪				
Slate ..... 0 6 ⎪				
Coal ..... 0 3 ⎭				
Fire clay.....	4	8	137	4
Sandstone	8	0	145	4
Slate, dark.....	6	6	151	10
Fire clay	4	5	156	3
Limestone	12	11	169	2
Fire clay.....	5	4	174	6
Sandstone	8	8	183	2
Slate, dark.....	19	5	202	7
Sandstone	17	3	219	10
Fire clay.....	9	3	229	1
Shale, blue	6	0	235	1
Sandstone, (Arnoldsburg).....	15	0	250	0
Fire clay.....	12	0	262	1
Slate, gray	16	0	278	1
Limestone	1	8	279	9
Fire clay.....	2	0	281	9
Limestone	17	5	299	2
Fire clay.....	7	5	306	7
Limestone	6	0	312	7
Shale, blue.....	9	0	321	7
Limestone	9	0	330	7
Shale, blue.....	6	0	336	7
Limestone	7	0	343	7
Sandstone, gray (Sewickley).....	65	0	408	7
Slate	0	1	408	8
Coal ..... 5′ 8″ ⎫ Sewickley	5	9	414	5
Coal and slate. 0 1 ⎭ (Elevation of base, 744.6′ L-A. T.)				
Fire clay.....	4	7	419	0
Limestone	15	3	434	3
Fire clay.....	4	0	438	3
Limestone	4	0	442	3
Fire clay	2	0	444	3
Limestone	16	8	460	11
Fire clay.....	2	5	463	4

	Thickness. Ft.	In.	Total. Ft.	In.
Coal, (Redstone)	1	3	464	7
Slate, dark	1	9	466	4
Limestone	11	2	477	6
Fire clay	2	3	479	9
Sandstone	0	10	480	7
Shale, sandy	3	4	483	11
Slate and coal..... 2′ 8″				
Coal 0 2				
Slate, black..... 1 4				
Coal ..... 0 4 — Pittsburgh	12	8	496	7
Slate and fire clay.. 0 6 — (Elevation of base,				
Coal ..... 0 10 — 662.4′ L-A. T.)				
Slate 0 1				
Coal 6 9				
Fire clay to bottom	1	8	498	3

Joseph E. Lynch Coal Test No. 5 (308).

Grant district, 1.8 miles north of Georgetown. Authority, Consolidation Coal Company.

(Elevation, 1068.3′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone, sandstone and shale	50	6	50	6
Slate, dark, Uniontown coal	6	0	56	6
Shale and sandstone	52	4	108	10
Slate, black, Lower Uniontown coal	0	4	109	2
Shale, limestones and sandstones	142	11	252	1
Sandstone and slate in layers	16	3	268	4
Coal, Sewickley (Elevation of base, 794.4′ L-A. T..	5	7	273	11
Fire clay	4	0	277	11
Slate, black	1	4	279	3
Sandstone	12	5	291	8
Fire clay	8	5	300	1
Limestone	20	8	320	9
Fire clay	3	6	324	3
Coal, Redstone	1	8	325	11
Slate and fire clay	1	9	327	8
Limestone	14	6	342	2
Slate and fire clay	10	9	352	11
Coal ..... 4′ 7″				
Sulphur ball.. 0 1 — Pittsburgh	8	0	360	11
Coal ..... 3 4 — (Elevation of base,				
707.4′ L-A. T.)				
Sandy shale to bottom	2	7	363	6

A. C. Barker Coal Test No. 6 (314).

Grant district, 1.2 miles northeast of Georgetown. Authority, Consolidation Coal Company.

(Elevation, 998.99′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone and shale	169	2	169	2
Sandstone, Sewickley	11	0	180	2
Slate, dark	3	5	183	7
Coal ....0′ 6″				
Binder ..0 1 — Upper Sewickley	6	5	190	0
Coal .....5 10 — (Elevation of base, 808.99′ L-A. T.)				

	Thickness. Ft.	In.	Total. Ft.	In.
Dark slate	5	4	195	4
Limestone	12	0	207	4
Fire clay	8	4	215	8
Coal and slate, Lower Sewickley	0	5	216	1
Limestone	4	10	220	11
Shale, light	1	0	221	11
Limestone	7	3	229	2
Fire clay and lime	9	0	238	2
Fire clay	6	7	244	9
Coal, Redstone	2	0	246	9
Limestone	17	0	263	9
Slate and fire clay	5	2	268	11
Coal 0′ 1″ / Slate, dark 2 10 / Coal 1 0 / Fire clay, soft 0 8 / Coal 2 2 / Sulphur binder 0 1 / Coal 6 1 — **Pittsburgh** (Elevation of base, 717.2′ L-A. T.)	12	11	281	10
Fire clay and shale to bottom	1	11	283	9

C. M. Arnett Coal Test No. 7 (313).

Grant district, 0.3 mile northwest of Arnettsville. Authority, Consolidation Coal Company.

(Elevation, 950.7′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, limestone and shale	56	1	56	1
Sandstone, Sewickley	58	9	114	10
Coal, Upper Sewickley	4	11	119	9
Fire clay and limestone	65	7	185	4
Sandstone, Upper Pittsburgh	37	6	222	10
Coal 0′ 8″ / Slate 0 6 / Coal 8 3 — **Pittsburgh** (Elevation of base, 718.5′ L-A. T.)	9	5	232	3
Fire clay to bottom	1	4	233	7

S. C. Stewart Coal Test No. 8 (309).

Grant district, 1.8 miles northwest of Arnettsville. Authority, Consolidation Coal Company.

(Elevation, 1082.8′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface	2	9	2	9
Sandstone, Waynesburg	27	0	29	9
Slate, black	1	3	31	0
Coal 0′ 8″ / Fire clay 0 11 / Slate 1 0 / Coal 1 10 / Slate 0 11 / Coal 1 8 — **Waynesburg**	7	0	38	0
Fire clay	12	0	50	0
Sandstone	8	0	58	0
Slate	12	0	70	0
Limestone	15	0	85	0

			Thickness.		Total.	
			Ft.	In.	Ft.	In.
Shale, blue			12	0	152	0
Limestone			13	0	165	0
Shale, red			6	0	171	0
Sandstone			4	0	175	0
Shale, green			10	0	185	0
Limestone			30	0	215	0
Green shale			20	0	235	0
Limestone			24	0	259	0
Sandstone, Sewickley			66	5	325	5
Coal, Sewickley			3	3	328	8
Fire clay			4	6	333	2
Limestone and fire clay			61	8	394	10
Slate and fire clay			6	0	400	10
Coal and slate	4′	2″				
Black carbon slate	1	4				
Clay, soft	1	0				
Coal	0	5				
Binder	0	3	Pittsburgh (Elevation of base, 666.8′ L-A. T.)		416	0
Coal	1	3				
Binder	0	5				
Coal	2	2½				
Binder	0	1				
Coal	4	0½				
Fire clay to bottom			1	8	417	8

Martha A. Miller Coal Test No. 9 (234).

Clay district, at Hagans. Authority, Consolidation Coal Co.

(Elevation, 1010.25′ L-A. T.)			Thickness. Ft.	In.	Total. Ft.	In.
Shale, blue			10	0	95	0
Sandstone			9	0	104	0
Slate and fire clay			28	0	132	0
Limestone			8	0	140	0
Surface, sandstone, limestone and shale			68	1	68	1
Coal and slate, Uniontown			0	2	68	3
Limestone, sandstone and shale			173	3	246	6
Slate, dark			18	5	264	11
Coal	5′	8″				
Binder	0	3	Sewickley (Elevation of base, 738.6′ L-A. T.)		6	8	271	7
Coal and sulphur	0	9						
Fire clay			7	3	278	10
Limestone			12	9	291	7
Fire clay			12	8	304	3
Limestone			26	6	330	9
Slate, black			0	4	331	1
Coal	2′	6″				
Slate	0	7	Redstone		3	3	334	4
Coal	0	2						
Slate, dark			6	4	340	8
Sandstone			0	9	341	5
Clay, soft			0	3	341	8

	Thickness. Ft.	In.	Total. Ft.	In.
Dark slate and coal ..... 2′ 0″ } Lost core, which probably represents Pittsburgh coal				
Fire clay.....11 4 } cut out by clay vein.....	13	4	355	0
Shale, gray.....	2	0	357	0
Sandstone	26	5	383	5
Shale, blue.....	3	4	386	9
Shale and fire clay to bottom.....	10	7	397	4

Another test called No. 9′ by the company was made on the same farm and at about the same elevation, the record of which is as follows:

Martha A. Miller Coal Test No. 9′ (234).

Clay district, at Hagans. Authority, Consolidation Coal Company.

(Elevation, 1009.58′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, sandstone and fire clay.....	22	3	22	3
Coal, Uniontown.....	0	3	22	6
Limestone, sandstone and slate.....	41	11	64	5
Slate and coal, Lower Uniontown.....	0	2	64	7
Sandstone, limestone and shale.....	162	8	227	3
Shale, dark, sandy.....	37	5	264	8
Coal ..... 5′ 7″				
Binder ..... 0 3 } Sewickley	6	4	271	0
Coal and slate .. 0 6				
Fire clay, limestone and fire clay.....	57	10	328	10
Coal .....2′ 10″				
Slate ..... 1 0 } (Redstone)	4	1	332	11
Coal, bony..... 0 3				
Slate, black.....	0	4	333	3
Shale, sandy.....	5	5	338	8
Fire clay.....	0	4	339	0
Slate	0	6	339	6
Sandstone, dark.....	0	4	339	10
Coal, Pittsburgh (elevation of base, 663.92′ L-A. T.)	5	10	345	8
Fire clay to bottom.....	1	11	347	7

Mary J. Lynch Coal Test No. 10 (311).

Grant district, 1.8 miles northwest of Arnettsville. Authority, Consolidation Coal Company.

(Elevation, 979.67′ L-A. T.)	Thickness. Ft.	In.	Total. Ft.	In.
Surface, sandstone, shale and limestone.....	125	3	125	3
Sandstone, Sewickley	44	4	169	7
Shale, dark	4	1	173	8
Sandstone	3	2	176	10
Slate, dark.....	2	2	179	0

		Thickness. Ft.	In.	Total. Ft.	In.
Coal .....3′ 0″ Binder .....0 1 Coal .....1 11 Binder .....0 1 Sulphur and coal..0 11 Fire clay, shaly..0 11 Coal 0 11	Upper Sewickley.....	7	10	186	10
Fire clay, limestone and fire clay.....		49	5	236	3
Coal, Redstone		1	0	237	3
Fire clay		21	9	259	0
Slate, dark		2	10	261	10
Coal .....0′ 4″ Slate ....0 10 Coal 6 9	Pittsburgh ..... (Elevation of base, 709.92′ L-A. T.)	7	11	269	9
Fire clay to bottom.....		2	5	272	2

The Waynesburg Coal.

The Waynesburg coal, described in detail in Chapter VI., will prove to be a valuable resource. As shown by the Table of Coal Analyses, its sulphur content is but little higher than in considerable areas of the Pittsburgh coal, some of the mines being low enough in this impurity to make them available for coke manufacture. The principal objection to the coal is the large parting of shale usually found near the center of the seam. Owing to the fine thickness of the coal, often reaching 10 feet, it is possible to dispose of this shale by "gobbing" it within the mine, thus saving the expense of hauling it out. The value of the Waynesburg coal has been underestimated because of the great amount of Pittsburgh coal available in the same region. Its outcrop is shown in detail on Map II.

Quantity of Waynesburg Coal Available.

In western Monongalia and Marion counties, where the Waynesburg coal lies under drainage, its thickness has been noted in numerous oil well records. These records are sufficiently well distributed, as the following table will show, to authorize the statement that the Waynesburg coal is of minable thickness at all points within this district west of its outcrop.

Figure 5.—Showing area of Waynesburg Coal.

List of Wells Recording Waynesburg Coal.

No. on Map.	NAME OF WELL.	LOCATION.	Elevation of Well Mouth. A. T.	Depth Feet.	Thickness. Feet.
	Monongalia County				
3	Kinzey Renner Hrs. No. 1	Garrison, 1.1 m. SW.	1115B	590	4
5	Eli White No. 1	St. Cloud, 1.6 m. NE	1075B	500	5
8	John G. White No. 1.	Maple, 0.7 m. W.	1150B	780	5
10	Thos. White No. 1.	Maple, 0.4 m. NE	1065B	450	6
12	J. P. Hagan No. 2.	Hero, 0.9 m. W.	1095B	480	3
20	T. W. Kinnan No. 1.	Jollytown, 1 m. SE	1060B	440	..
35	Elijah C. Clovis No. 1	St. Cloud, 1.1 m. E.	1165B	585	3
38	Nancy Hostutler No. 1	St. Cloud, 0.7 m. SE.	1200B	645	5
47	Jacob (B. F.) Liming No. 1	Cottontown, 1.3 m. E.	1370B	849	2
53	John Estel Hrs. No. 1	St. Leo, 1 m. N 15° E.	....	945	4
80	M. J. Garrison No. 1.	Wadestown, 1.2 m. SE.	1120B	524	5
82	M. J. & J. L. Garrison No. 1831	Wadestown, 1.1 m. S 10° E.	....	680	..
90	Sam'l Eakin No. 1	St. Leo, 1.8 m. E.	1125B	560	4
93	M. J. (Crocker) Garrison No. 1	Wadestown, 1.4 m. S.	1075B	525	5
96	Wilson Haught No. 4	St. Leo, 0.9 m. NE.	....	887	..
117	Corbra Anderson No. 2	Ragtown, 1.3 m. SW.	1617L	955	5
147	Sol Meyers No. 1	Blacksville, 1.2 m. S.	1104L	400	..
148	Sol Meyers No. 1	Blacksville, 1.3 m. S 10° W.	1110B	400	..
149	Reason Sine No. 1.	Blacksville, 1.5 m. S.	1239L	540	0
152	Asa Lemley No. 2.	Blacksville, 2.1 m. S.	1195B	480	7
153	James Lemley Hrs. No. 1	Daybrook, 1.6 m. NW.	1225B	515	..
168	Grant Stephens	Mooresville	960B	105	2.5
171	Etta Core No. 2268.	Worley, 0.5 m. SW.	1345B	485	5
172	Lee R. Shriver No. 2.	Worley, 0.6 m. NE.	965B	195	..
176	Lee R. Shriver No. 1.	Worley, 0.8 m. NE.	925B	195	..
211	D. J. Eddy	Behler, 0.5 m. S.	1058L	126	7.6
217	M. C. Wildman No. 1123	Pedlar, 0.2 m. NE	1130B	316	5
230	Martha A. Miller No. 1	Hagans, 2.2 m. NE.	1225B	216	6
232	Cal Hawkins No. 1.	Hagans, 0.5 m. E	....	210	6
250	Bowen Wade No. 2.	Bowlby, 0.9 m. N 20° E.	1190B	55	9

No. on Map.	NAME OF WELL.	LOCATION.	Elevation of Well Mouth. A. T.	Depth Feet.	Thickness. Feet.
254	Spencer Cunningham No. 1.....	Bowlby, 1.2 m. W.	1195B	145	5
255	Iona Bowlby No. 4..	Bowlby, 0.6 m. S 80° W.....	1220B	99	6
256	H. C. Bowlby No. 5..	Bowlby, 1.0 m. SW.	....	352	8
257	E. Brand No. 2.....	Bowlby, 1.2 m. SW.	....	147	6
259	Wm. McCormick No. 2.....	Bowlby, 1.5 m. SW.	1245B	100	8
260	Frank McCormick No. 1.....	Bowlby, 1.4 m. SW.	1215B	65	5
262	Mark Weaver No. 1..	Bowlby, 1.9 m. SW.	1130B	100	8
269	David Henderson No. 1.....	Cassville, 1.3 m. S 75° W.....	1340B	307	5
291	L. S. Bircher No. 1..	Cassville, 1.4 m. SE.	1335B	170	6
294	J. C. Brand No. 2...	Cassville, 2 m. SW.	....	320	7
295	Eugene Snyder No. 1.	Hagans, 2.3 m. NE.	....	60	5
298	Martha A. Miller No. 2.....	Hagans, 2.1 m. NE.	1255B	240	..
300	J. N. Michael No. 1998	Hagans, 1.8 m. NE.	1305B	315	4
303	J. N. Michael coal test No. 2.....	Hagans, 1.8 m. NE	1159L	124	8.2
309	S. C. Stewart coal test No. 8.....	Arnettsville, 1.8 m. NW.....	1083L	31	7
	Marion County:				
354	A. M. Glover No. 4..	Glover Gap, 0.6 m. NW.....	1160B	600	3
355	A. M. Glover No. 3..	Glover Gap, 0.6 m. NW.....	1070B	508	4
372	Riley Arnett No. 1..	Rymer, 1.1 m. W.	1055B	500	5
469	Alexander Huey No. 1.....	Curtisville, 1.3 m. S.	....	442	11
497	Geo. Furbee No.1....	Mannington, 0.5 m. NW.....	968B	60	4
536	Lindsay Blaker No. 1.....	Pleasantville, 0.7 m. NE.....	1115B	155	3
555	Brice Wallace No.1.	Fairview, 1 m. NE.	1025B	137	7
556	David Jones No. 5..	Fairview, 0.9 m. N 10° W.....	....	320	4
591	Wm. Wallace No. 1.	Fairview, 2.1 m. SW.	1110B	197	2
599	Rezin Amos No. 1..	Downs, 1.3 m. N.	1117L	110	4
634A	Absalom Martin core test No. 1.....	Festus, 2 m. NW.	1122L	29	6

With the data contained in the foregoing table and with the thickness shown at many openings described in Chapter VI an average thickness of 3.5 feet is conservative and with areas determined by planimeter from Map II the following tonnage estimate has been made by Reger of the Waynesburg coal:

Available Waynesburg Coal.

Counties by Districts.	Square Miles.	Acres.	Cubic Feet of Coal	Short Tons of Coal
Monongalia:				
Battelle	56.40	36,096	5,403,196,160	216,127,846
Clay	63.43	40,595	6,199,113,700	247,964,548
Cass	16.69	10,682	1,628,576,720	65,143,069
Grant	17.69	11,322	1,726,152,120	69,046,085
Totals	154.21	98,695	14,957,038,700	598,281,548
Marion:				
Mannington	98.30	62,912	9,591,562,520	383,662,501
Pawpaw	29.60	18,944	2,888,202,240	115,528,090
Lincoln	42.44	27,162	4,141,118,520	165,644,741
Fairmont	9.35	5,984	912,320,640	36,492,826
Grant	0.52	333	50,769,180	2,030,767
Totals	180.21	115,335	17,583,973,100	703,358,925
Totals for Area	334.42	214,030	32,541,011,800	1,301,640,473

The Sewickley Coal.

The Sewickley coal, described briefly in Chapter VI, is another coal that has been greatly overshadowed by the Pittsburgh. In the western districts of Monongalia and Marion counties where it lies far under drainage, few records of any sort are available to determine its chemical character. The only exception is the sample obtained from the T. W. Kinnan gas well in Battelle district, saved by the driller and published in the Table of Coal Analyses. In central Monongalia and Marion, however, numerous tests have been made to show that the coal is one to two per cent higher in sulphur than the Pittsburgh coal, slightly higher in ash, and but little inferior in British thermal units. The high sulphur content makes it objectionable for coke manufacture, but it is an excellent coal for steam or heating purposes. In the territory of this report it is mined commercially at only one place, near Rivesville, Marion county, where the following information was obtained.

Photo by Ray Bricker.

PLATE XXVIII.—Topography of the Monongahela Series and Mine of the Parker Run Coal & Coke Company (No. 15 on Map II) in the Sewickley coal, showing combination railroad and river tipple, at Rivesville, Marion County.

Parker Run Coal & Coke Co., Parker Run Mine.—No. 15 on Map II.

Located ½ mile east of Rivesville; **Sewickley coal.**

		Ft.	In.
1.	Shale, gray.....		
2.	Coal, good.....3'	8 "	
3.	Bone 0	0¾	
4.	Coal, good.....2	3	
5.	Shale, gray, hard.....0	1	
6.	Coal, hard.....0	9 6	9¾
7.	Fire clay.....		

"Tidal elevation, 907' spirit level; principal office, Rivesville; daily capacity, 500 tons; 10 laborers and 25 miners employed; horse haulage; used for steam and domestic fuel; shipped north, east and west; butts, N 78° W; faces, N 12° E; greatest rise, S 60° E; sample collected for analysis from Nos. 2 and 4 of section in Room No. 27 of Second Right Heading by D. B. Reger; C. Kelley, Superintendent. authority for data."

An analysis of this coal was published in Bulletin II of the Survey Reports under table 17, opposite page 312, which shows a somewhat higher thermal unit result than the one obtained at the section above.

Dakota Coal & Coke Co.—No. 15(A) on Map II.

Located at Dakota; **Sewickley coal.**

This mine does not at present operate the Sewickley coal but it was sampled by the Survey a few years ago.

In addition to the information obtained in the Table of Coal Analyses in this report, numerous other tests have been made of the Sewickley coal which are assembled in the following table.

Table of Sewickley Coal Analyses.

Analysis No.	Mois.	V.M.	F.C.	Ash.	Sul.	Phos.	B.T.U.
1	1.03	35.83	53.93	9.21	2.72	0.011	13355
2	1.64	34.55	51.87	11.94	3.59	0.010	12859
3	1.23	33.23	54.67	10.87	1.45	0.008	13417
4	0.64	34.57	54.22	10.57	2.88	0.005	12983
5	1.25	38.47	51.57	8.71	4.62	0.0057	13231
6	1.13	37.29	49.26	12.32	4.91	0.006	12726
7	1.03	39.90	47.19	11.88	4.80	.....	.....
8	1.40	38.15	49.87	10.58	3.47	.....	.....
9	0.75	34.17	52.24	12.84	2.82	0.015	12642
10	1.42	37.37	51.79	9.42	4.33	.....	.....
11	1.14	36.62	50.90	11.34	4.52	.....	.....
12	1.26	37.24	52.14	9.36	4.60	.....	....

Analysis No.	Mois.	V.M.	F.C.	Ash.	Sul.	Phos.	B.T.U.
13	1.36	36.40	47.70	14.54	5.34	.....	.....
14	1.30	36.70	51.16	9.84	4.10	.....	.....
15	1.60	35.20	51.04	12.16	3.08	.....	.....
16	1.54	39.00	48.06	11.40	4.84	.....	.....
17	1.36	39.08	48.32	11.24	4.96	.....	.....
18	1.30	34.06	52.44	12.30	3.19	.....	.....
19	1.38	36.14	46.12	16.36	5.04	.....	.....
20	1.54	39.00	48.06	11.40	4.84	.....	.....
Average ..	1.26	36.65	50.63	11.41	4.00	0.009	13030

Note.—Analyses Nos. 1-9 inclusive are taken from Vol. II(A), W. Va. Geol. Survey. All B.T.U. determinations should be 500 to 800 points higher owing to calorimeter being out of adjustment. Nos. 10-19 inclusive are by chemical department of Consolidation Coal Company, courtesy of Frank Haas; No. 20 by Pittsburgh-Buffalo Company.

Location of Samples in Sewickley Coal Analyses.

1. Wm. Baremore mine, on Scotts run, Monongalia county.
2. Wm. Deets mine, on Scotts run, Monongalia county.
3. C. C. Lazzell mine, on Robinson's run, Monongalia county.
4. J. A. Cox mine, on Indian creek, Monongalia county.
5. Millard Boggess mine, six-tenths mile above mouth of Mill Fall run, Marion county.
6. Chas. Jackson mine, on Tevebaugh creek, Marion county.
7. Mine on Tevebaugh creek, one mile from West Fork river, Marion county.
8. D. T. Martin mine, near Sturms Mill, on Little Bingamon creek Marion county.
9. Jamison Coal & Coke Company No. 8 mine, 0.5 mile east of Underwood, Marion county.
10. W. P. Fortney coal test No. 3 (647), on Tevebaugh creek, Marion county.
11. Z. F. Davis coal test No. 4 (646), on Helens run, Marion county.
12. Nancy Martin coal test No. 6 (659), on Mill Fall run, Marion county.
13. Shore coal test No. 7 (672), on Ice's run, Marion county.
14. Morgan-Billingslee coal test No. 8 (669), on Buffalo creek, Marion county.
15. Curtis Fletcher coal test No. 9 (655), on Buffalo creek, Marion county.
16. W. S. Parish coal test No. 11 (638) on Tevebaugh creek, Marion county.
17. E. C. Morgan coal test No. 1 (663) on Helens run, Marion county.
18. Morgan-Fox coal test No. 14 (621), 0.5 mile north of Farmington, Marion county.
19. Nancy Billingsley coal test No. 5 (652), 0.5 mile northwest of Hutchinson, Marion county.
20. Absalom Martin coal test No. 1 (634A), 1.2 miles north of Annabelle, Marion county.

Attention is here called to the fact that the samples of Sewickley coal, taken in the mines of the Parker Run Coal & Coke Company (No. 15 on Map II) and the Dakota Coal & Coke Company (No. 15A on Map II) and published in the Table of Coal Analyses at the end of this chapter, show a better average analysis than those of the foregoing table. Since this is due to more favorable conditions for sampling, the two mines referred to probably represent the coal better than the miscellaneous list.

In the Summer of 1913 a core test was drilled in the southwest corner of Monongalia county that penetrates the Sewickley coal as well as several coals of the Dunkard series above. Owing to an accident by which the drilling tools were lost in the hole the Pittsburgh coal was not reached by about 40 feet. The well starts 56 feet, by hand-level measurement, below the Nineveh sandstone and must therefore start about 50 feet below the Nineveh coal which was not visible at any point in the immediate vicinity of the well, but may be seen in the public road 0.4 westward where it is 6 inches thick. The well record was furnished the Survey through the courtesy of J. V. Thompson of Uniontown, Pa., at the request of John W. Boileau, the eminent coal expert of Pittsburgh, Pa., and reads as follows:

Eli Delaney Core Test (100A).

Battelle district, 1 mile southwest of St. Leo. Authority, S. J. Harry Diamond Core Drilling Company of Connellsville, Pa.

	Thickness.		Total.	
	Ft.	In.	Ft.	In
Surface	20	0	20	0
Green shale	20	6	40	6
Red shale	9	2	49	8
Sand shale	7	2	56	10
Green shale	14	0	70	10
Red shale	..	8	71	6
Green shale	..	6	72	0
Red shale	..	6	72	6
Green shale	20	6	93	0
Red shale	7	0	100	0
Sand shale	10	0	110	0
Green shale	25	0	135	0
Sand shale	48	0	183	0
Slate	10	0	193	0
Sandstone, (Rush Run)	10	0	203	0
Limestone	3	0	206	0
Green shale	10	6	216	6

	Thickness.		Total.	
	Ft.	In.	Ft.	In.
Red shale	1	2	217	8
Green shale	5	6	223	2
Red shale	1	3	224	5
Green shale	18	0	242	5
Sand shale	2	2	244	7
Green shale	3	0	247	7
Red shale	0	10	248	5
Green shale	27	0	275	5
Sandstone	5	2	280	7
Green shale	30	0	310	7
Sandstone, (Upper Marietta)	21	2	331	9
Green shale	4	0	335	9
Sand shale	2	6	338	3
Green shale	5	0	343	3
Limetsone	1	9	345	0
Lime shale	2	0	347	0
Sandstone	7	9	354	9
Lime shale	8	5	363	2
Red shale	1	6	364	8
Lime shale	20	0	384	8
Red shale	2	0	386	8
Lime shale	24	0	410	8
Sand shale	32	0	442	8
Slate	5	9	448	5
Coal, (Washington)	0	4	448	9
Slate	0	5	449	2
Sand	9	6	458	8
Slate	6	0	464	8
Lime shale	5	3	469	11
Sand slate	6	6	476	5
Coal, (Little Washington)	0	4	476	9
Green shale	22	0	498	9
Sand shale	47	2	545	11
Slate	1	3	547	2
Coal, (Waynesburg "A")	2	0	549	2
Slate	0	9	549	11
Lime shale	11	10	561	9
Sand shale	41	3	603	0
Slate	2	8	605	8
Coal, (Waynesburg)	2	4	608	0
Sandstone	2	0	610	0
Sand shale	51	0	661	0
Green shale	8	9	669	9
Sandstone, (Uniontown)	50	3	720	0
Lime shale	27	0	747	0
Green shale	11	0	758	0
Red shale	3	0	761	0
Lime and shale	10	0	771	0
Limestone	2	6	773	6
Lime shale	2	6	776	0
Limestone	15	0	791	0
Lime shale	6	8	797	8
Red shale	1	4	799	0
Limestone, (Benwood)	68	0	867	0
Slate	2	6	869	6
Coal, (Sewickley)	5	0	874	6
Fire clay	2	6	877	0

		Thickness. Ft.	In.	Total. Ft.	In.
Limestone .....4′ 0″					
Lime shale.....2 0	Sewickley limestone..	12	6	889	6
Limestone 6 6					
Sand shale		1	7	891	1
Sandstone		4	5	895	6
Lime shale		10	6	906	0
Limestone		27	0	933	0

The B. & O. Railroad, under the direction of C. McC. Lemley, has recently (1911) made extensive investigations of the Sewickley coal in Monongalia county. The following farms, mines and prospects were sampled by employees of the railroad and the samples analyzed in the laboratory of the Survey by Mr. Krak. For convenience the analyses are grouped on a subsequent page.

Harvey Fisher Mine.

Located opposite Round Bottom; **Sewickley coal.**

		Feet.	Inches.
0.	Sandstone roof, about.....	25	0
1.	Slate	0	3
2.	Coal .....1′ 6 ″		
3.	Slate, bone. 0′0½″ to...0 0¼		
4.	Coal 1 7		
5.	Bone 0′ 0½″ to.....0 0¼		
6.	Coal 1 4		
7.	Clay, 0′2″ to.....0 0		
8.	Coal 1 5		
9.	Fire clay.....0 3		
10.	Coal 0 2		
11.	Fire clay.....0 2		
12.	Coal 0 6	6	11½

13. Fire clay.

"Tidal elevation, 1230′, aneroid; sample taken from Nos. 2-8 on outcrop, no entry made, just faced, by J. C. Heilig and R. C. Tucker." Sample published under B. & O. Railroad Table.

Markley Mine.

Located on Indian creek, 1 mile from Opekiska; **Sewickley coal.**

		Feet.	Inches.
1.	Sandstone-slate roof.....		
2.	Coal .....0′ 6 ″		
3.	Slate 0 0¼		
4.	Coal 0 10		
5.	Parting 0 0¼		
6.	Coal 1 4		
7.	Bone coal.....0 1		
8.	Coal 1 7		
9.	Parting 0 0¼		

		Feet.	Inches.
10.	Coal 0	8	
11.	Fire clay parting..... 0	0½	
12.	Coal 0	2	5 3¼

13. Slate.

"Tidal elevation, 960', aneroid; butts, N 69° W; faces, N 21° E; sample collected from Nos. 2, 4, 6, 8, 10 and 12, by J. C. Heilig and R. C. Tucker." Sample published under B. & O. Railroad Table.

David McLaughlin Mine.

Located at Laurel Point; Sewickley coal.

		Feet.	Inches.
1.	Sandstone roof.....		
2.	Coal ..... 0'	11 "	
3.	Clay parting..... 0	0½	
4.	Coal 0	8	
5.	Clay parting, 0" to..... 0	1	
6.	Coal 0	4	
7.	Bone 0	0½	
8.	Coal 0	5	
9.	Clay 0	0½	
10.	Coal, streaked with bone... 1	3	
11.	Slate 0	0¼	
12.	Coal 0	1	
13.	Slate 0	0⅛	
14.	Coal 0	2	
15.	Slate 0	0⅛	
16.	Coal 0	4	
17.	Slate 0	0¼	
18.	Coal 0	3	
19.	Slate 0	0¼	
20.	Coal 0	2	
21.	Slate 0	0¼	
22.	Coal (appears clean)..... 1	4	6 2¾

23. Slate bottom.....

"Tidal elevation, 1040', aneroid; butts, N 71° W; faces N 19° E; sample collected from all numbers containing coal, 150' in mine at last working face, by J. C. Heilig and R. C. Tucker." Sample published in B. & O. Railroad Table.

B. & O. Railroad Table of Analyses—Sewickley Coal.

Chemical Work by J. B. Krak.

Mine.	Mois.	V. M.	F. C.	Ash.	Sul.	Phos.
Harvey Fisher (prospect).	4.31	33.54	55.00	7.15	1.84	0.003
Markley	1.61	36.72	54.30	7.37	2.65	0.0003
David McLaughlin.....	1.08	36.98	52.21	9.73	4.30	0.0003
Average.....	2.33	35.75	53.84	8.08	2.93	0.0018

Figure 6.—Showing area of Sewickley Coal.

Quantity of Sewickley Coal Available.

Since the Sewickley Coal lies only about 100 feet above the Pittsburgh, its outcrop is not shown on Map II, but it may easily be determined at any point desired. In the western districts of Monongalia and Marion counties where it lies under drainage it has been usually noted in oil well records, which are sufficiently numerous to show that it is generally present in good thickness. The following table shows the extent of the coal with great probability:

List of Wells Recording Sewickley Coal.

No. on Map	Name of Well.	Location.	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
	Monongalia County:				
1	John E. Snyder No. 1	St. Cloud, 1.2 m. N 30° W.....	1425B	1095	5
3	Kinzey Renner Hrs. No. 1.....	Garrison, 1.1 m. SW	1115B	804	6
7	James L. White No. 1	St. Cloud, 1 m, NE	1240B	889	6
8	John G. White No. 1	Maple, 0.7 m. W	1150B	780	4
9	Simon L. White No. 1	Maple	1130B	755	..
10	Thomas White No. 1	Maple, 0.4 m. NE	1065B	694	5
12	J. P. Hagan No. 2..	Hero, 0.9 m. W..	1095B	712	4
13	J. P. Hagan No. 1...	Hero, 0.6 m. W..	1040B	642	..
20	T. W. Kinnan No. 1..	Jollytown, 1 m. SE	1060B	695	6
23	Minerva Hennen No. 1	Wise, 0.4 m, N 20° E.	1050B	667	3
26	Mary A. Eakin No. 1.	Wadestown, 1.2 m. NE.....	1005B	684	..
32	L. H. & R. Wilson No. 1.....	Wadestown, 0.4 m. SE.....	1159L	865	5
33	E. B. Bell No. 2239..	Wadestown, 0.4 m. NW.....	....	765	..
35	Elijah C. Clovis No. 1	St. Cloud, 1.1 m. E	1165B	825	7
37	Barnett Renner No. 2165.....	St. Cloud, 0.3 m. SW	1365L	1044	..
38	Nancy Hostutler No. 1.....	St. Cloud, 0.7 m. SE	1200B	890	5
40	Nancy Johnson No. 1	St. Cloud, 1.1 m. SE	1095B	756	4

No. on Map	Name of Well.	Location.	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
44A	Marion Henderson No. 2411	St. Leo, 2.2 m. NW	....	830	..
47	Jacob (B. F.) Liming No. 1	Cottontown, 1.3 m. E	1370B	1095	5
50	Amy Maple No. 1	Wadestown, 2 m. St. Leo, 1.7 m.	....	910	..
51	Fred O. Liming No. 2326	NW ... . SW	1240B	950	..
53	John Estel Heirs No. 1	St. Leo, 1 m. N 15° E	....	1242	6
80	M. J. Garrison No. 1	Wadestown, 1.2 m. SE	1120B	791	9
86	F. M. Efaw No. 1	Crossroads, 1.1 m. S 5° W	....	824	..
87	F. M. Efaw No. 3	Galletin, 1.5 m. N	1115L	774	4
88	Amon Johnson No. 2	Galletin, 1.6 m. N	1083L	746	6
89	Samuel Eakin No. 4	St. Leo, 1.7 m. E	1155B	865	8
90	Samuel Eakin No. 1	St Leo, 1.8 m. E	1125B	827	7
93	M. J. (Crocker) Garrison No. 1	Wadestown, 1.4 m. S	1075B	790	9
94	M. J. Garrison No. 2	St. Leo, 1.4 m. NW	1055B	785	8
95	Joseph Estil No. 9	St. Leo, 1.1 m. NE	1105B	825	..
96	Wilson Haught No. 4	St. Leo, 0.9 m. NE	....	1148	4
99	J. M. Hall No. 2	St. Leo, 0.2 m. N	....	1060	..
103	F. M. Renner No. 1	St. Leo, 0.7 m. S 15° E	1103L	830	..
107	W. A. Yost No. 5	St. Leo, 1.4 m. SE	1295B	1000	..
109	T. C. Gallagher No. 2	Galletin, 0.5 m. NE	1632L	1202	..
117	Corbra Anderson No. 2	Ragtown, 1.3 m. SW	1617L	1220	7
135	Estella & R. S. Lantz No. 1589	Blacksville. 0.5 m. W	....	546	..
136	Estella & R. S. Lantz No. 1575	Blacksville, 0.4 m. SW	955B	490	..
137	Estella & R. S. Lantz No. 1576	Blacksville	953L	476	..
147	Sol Meyers No. 1	Blacksville, 1.2 m. S	1104L	655	..
148	Sol Meyers No. 1	Blacksville, 1.3 m. S 10° W	1110B	648	..
149	Reason Sine No. 1	Blacksville, 1.5 m. S	1239L	792	..
150	Alpheus Sine No. 1	Blacksville, 1.5 m. S 5° W	1152L	700	..

No. on Map	Name of Well	Location.	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
152	Asa Lemley No. 2..	Blacksville, 2.1 m. S 10° W...	1195B	750	7
153	James Lemley Hrs. No. 1.....	Daybrook, 1.6 m. NW	1225B	780	..
168	Grant Stephens	Mooresville	960B	394	7
171	Etta Core No. 2268..	Worley, 0.5 m. SW	1345B	808	7
172	Lee R. Shriver No. 2	Worley, 0.6 m. NE	965B	454	..
174	Lee R. Shriver No. 3	Worley, 0.8 m. NE	975B	448	..
176	Lee R. Shriver No. 1	Worley, 0.8 m. NE	925B	454	..
211	D. J. Eddy.....	Behler, 0.5 m. S	1058L	383.5	6.7
214	C. E. Johnson No. 8..	Pedlar, 0.8 m. SE	1280B	680	..
224	J. C. and R. Morris No. 1.....	Core, 2 m. S 15 E	1205B	500	..
230	Martha A. Miller No. 1.....	Hagans, 2.2 m. NE	1225	488	6
232	Cal Hawkins No. 1..	Hagans, 0.5 m. E	....	495	5
233	M. A. Miller No. 2..	Hagans, 0.2 m. S	1015B	282	4
234	M. A. Miller coal test No. 9'	Hagans	1010L	265	6.3
250	Bowen Wade No. 2..	Bowlby, 0.9 m. N 20° E.....	1190B	320	5
251	Iona Bowlby No. 3..	Bowlby, 0.5 m. NW	1130B	276	6
254	Spencer Cunningham, No. 1.....	Bowlby 1.2 m. W	1195B	435	5
255	Iona Bowlby No. 4..	Bowlby, 0.6 m. S 80° W.....	1220B	372	6
256	H. C. Bowlby No. 5..	Bowlby, 1.0 m. SW	....	617	8
257	E. Brand No. 2.....	Bowlby, 1.2 m. SW	....	411	6
259	Wm. McCormick No. 2.....	Bowlby, 1.5 m. SW	1245B	375	5
260	Frank McCormic.. No. 1.....	Bowlby, 1.4 m. SW	1215B	350	6
262	Mark Weaver No. 1..	Bowlby, 1.9 m. SW	1130B	385	5
263	Justus Brewer No. 1.	Cassville, 2.2 m. NE	1000B	130	6
266	Wm. Higgins No. 1..	Cassville, 0.8 m. E	955B	82	5
267	Mandedick Heirs coal test No. 3....	Cassville, 0.7 m. E	963L	76	4
269	David Henderson No. 1.....	Cassville, 1.3 m. S 75° W.....	1340B	586	6

No. on Map	Name of Well.	Location.	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
272	John Laird (E. Roach) No. 1.....	Maidsville, 1.8 m. S 80° W....	1135B	187	5
273	Elza Davis No. 1...	Maidsville, 1.1 m. W.....	1050B	71	5
274	Wm. H. Smith No. 1.	Cassville, 1.1 m. W	1155B	190	5
281	Peter Lazzell No. 1.	Maidsville, 1.3 NW	1170B	134	7
283	T. A. & J. F. Keenan No. 1.....	Maidsville, 1.2 m. N 50° W...	1035B	18	5
290	Sanford Barrickman No. 1.....	Cassville, 1.8 m. SE	1085B	178	6
291	L. S. Bircher No. 1..	Cassville, 1.4 m. SE	1335B	465	7
292	J. H. Cole coal test. No. 2.....	Cassville, 2 m. S	1058L	219	5.8
294	J. C. Brand No. 2...	Cassville, 2 m. SW	....	575	6
295	Eugene Snyder No. 1	Hagans, 2.3 m. NE	....	365	7
297	Jehu Davis No. 1...	Hagans, 2.2 m. NE	1490B	728	7
298	Martha A. Miller No. 2.....	Hagans, 2.1 m. NE	1255B	518	..
303	J. N. Michael coal test No. 4.....	Hagans, 1.8 m. NE	1159L	409	5.7
306	Alpheus Morris No. 2 (?).....	Hagans, 1.6 m. NE	1280B	508	7
308	Joseph E. Lynch coal test No. 5....	Georgetown, 1.8 m. N.....	1068L	268	5.6
309	S. C. Stewart coal test No. 8.....	Arnettsville, 1.8 m. NW	1083L	325	3.2
311	Mary J. Lynch coal test No. 10.....	Arnettsville, 1.8 m. NW.....	980L	179	7.8
313	C. M. Arnett coal test No. 7.....	Arnettsville, 0.3 m. NW	951L	115	5
314	A. C. Barker coal test No. 6.....	Georgetown, 1.2 m. NE	999L	184	6.4
315	E. W. Brand coal test No. 1.....	Laurel Point, 1 m. NW.....	1005L	117	7.8
	Marion County:				
347	Dorcas (T. J.) Ash No. 2.....	Glover Gap, 1.9 m. NW.....	1100B	814	3
348	L. A. Keenan No. 1..	Glover Gap, 1.9 m. N 30° W...	1135B	874	..
349	Rebecca Glover No. 1	Glover Gap, 1.4 m. NW.....	1460B	1185	5
351	John Glover No. 1..	Glover Gap, 1.1 m. NW.....	1460B	1185	5
353	A. M. Glover No. 2..	Glover Gap, 0.9 m. NW.....	1154L	850	5

No. on Map	Name of Well.	Location.	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
354	A. M. Glover No. 4..	Glover Gap, 0.6 m. NW.....	1160B	858	5
355	A. M. Glover No 3..	Glover Gap, 0.6 m. NW.....	1170B	755	5
361	Geo. W. Hamilton No. 1.....	Seven Pines, 2.4 m. NW.....	....	1065	..
364	James Toothman No. 1.....	Brink, 1.4 m. N..	1335B	960	6
371	Riley Arnett No. 2..	Rymer, 1.7 m. S 85° W.....	1120B	860	4
372	Riley Arnett No. 1..	Rymer, 1.1 m. W	1055B	769	5
373	Joseph Hayhurst No. 4.....	Rymer, 1.1 m. NW	1065B	790	..
377	George Watson No. 1	Seven Pines, 0.6 m. SE.....	1110B	770	2
383	John W. Batson No. 1.....	Seven Pines, 1.3 m. NE.....	1295B	984	..
384	John Baker No. 4...	Metz, 2.6 m. W.	....	4	60
388	B. Wells No. 1.....	Glover Gap, 1 m. S 20° E.....	1045B	700	..
389	Benj. Dodd No. 3...	Glover Gap, 0.8 m. S 5° E.....	1255B	910	4
393	August Sturm No. 2.	Glover Gap, 0.8 m N 75° E.....	1070B	750	..
394	Snodgrass Bros No. 3	Glover Gap, 0.6 m. SE	1055B	712	..
395	M. W. Sturm No. 2.	Glover Gap, 1 m. m. SE	....	982	4
400	Barnes & Fleming No. 2	Glover Gap, 1.3 m. S 80° E....	1320B	962	..
410	E. Moore Heirs No. 1	Metz, 2 m. N...	....	1090	5
412	E. Moore Heirs No. 2	Glover Gap, 1.9 m. E.....	1060B	750	5
414	Isaac Campbell No. 3	Metz, 2.2 m. N..	1100B	787	..
416	Eliz. Thomas No. 1..	Metz, 2.1 m. NE.	1086L	800	..
419	James Fox No. 1....	Mannington, 3 m. SW.....	1190B	910	5
423	Isaac F. Thomas No. 1.....	Galletin, 1.5 m. SW	1075B	700	..
431	Ash Fluharty No. 1..	Condit	1000L	506	..
436	Catherine Tennant No. 3.....	Metz, 0.9 m. SE.	1000B	618	4
437	Frank O. Price No. 1	Metz, 1.4 m. S 10° E.....	1050B	561	..
446	C. S. Pitzer No. 1...	Rymer, 1.3 m. N 80° E	1320B	885	5
447	J. L. Beatty No. 1...	Logansport, 1.2 m. N	1130B	678	5
448	A. J. Hayes No. 8...	Rymer, 1.1 m. NE	1300B	910	7
449	Benj. Grubb No. 3...	Rymer, 1 m. NE.	1080B	700	..

		Feet.	Inches
4.	Bone 0	0½	
5.	Coal 0	2½	
6.	Bone 0	0½	
7.	Coal 0	3	
8.	Bone 0	1	
9.	Coal 4	3	
10.	Bottom coal 0	4	8 10½
11.	Shale, gray.		

"Second sample collected for analysis from Nos. 3, 4, 5, 6, 7, and 9 of section in No. 3 Heading, Main North A by D. B. Reger."

The Jamison Coal & Coke Company through its general manager, M. W. Head, has furnished the Survey the following table of analyses, made partly by its own chemist and partly furnished by customers. According to Mr. Head the samples were taken from cars and represent 7½ feet of the coal seam. The table furnishes valuable data in Marion county where the coal lies under ground and where this company has developed a large mining industry for gas and by-product coking coal.

Jamison Coal & Coke Company, Table of Analyses; Pittsburgh Coal.

Date.	Mois.	V. M.	F. C.	Ash	Sul.
Analyses made in our Laboratory:					
Mine No. 7, ¾ coal.					
Sept. 11th	....	....	....	7.05	.80
Sept. 15th	....	....	....	5.61	1.24
Sept. 20th	....	....	....	5.04	1.23
Sept. 30th	....	....	....	5.75	.96
Oct. 12th	....	....	....	7.65	1.04
Oct. 30th	....	....	....	5.45	1.28
Mine No. 8, ¾ coal.					
Sept. 11th	....	....	....	5.65	.84
Sept. 14th	....	....	....	5.57	.69
Sept. 14th	....	....	....	5.11	.96
Nov. 16th	....	....	....	5.95	.84
Mine No. 8, Run of mine coal					
Oct. 4th	....	....	....	6.00	.72
Oct. 5th	....	....	....	8.14	.94
Oct. 6th	....	....	....	6.00	1.06
Nov. 29th	....	....	....	7.57	.96
Nov. 29th	....	....	....	8.96	1.04

Date.	Mois.	V. M.	F. C.	Ash	Sul.
Mine No. 9, ¾ coal.					
Sept. 14th	....	....	....	6.89	.94
Sept. 14th	....	....	....	4.74	.92
Dec. 21st.	....	....	....	5.30	.97
Mine No. 9, Run of Mine coal.					
Oct. 18th	....	....	....	6.21	1.24
Dec. 5th	....	....	....	5.40	1.19
Analyses made by customers:					
Mine No. 7, ¾ coal					
Nov. 20th	....	....	....	5.77	.94
Nov. 14th	....	....	....	7.63	1.04
Nov. 6th	....	....	....	6.60	1.18
Mine No. 8, ¾ coal.					
Sept. 30th	....	....	....	7.01	.70
Oct. 28th	....	....	....	4.90	.73
Oct. 4th	1.90	39.22	52.74	6.14	.69
Oct. 10th	1.40	37.90	53.70	7.00	.92
Mine No. 8, Run of mine coal.					
Feb. 14th	.77	36.53	54.60	8.10	1.02
Mar. 1st	.70	35.80	55.10	8.40	1.15
Mine No. 9, ¾ coal.					
Sept. 23rd.	....	....	....	5.25	.92
Oct. 19th.	....	....	....	5.70	.80

Consolidation Coal Co. No. 38 (Shaft Mine)—No. 33 on Map II.

Located at Barnstown Station, 1 mile north of Fairmont; **Pittsburgh ccal.**

		Feet.	Inches.
1.	Draw slate		
2.	Coal, head .....1′	6 ″	
3.	Coal 1	8	
4.	Bone 0	0¾	
5.	Coal 0	2	
6.	Bone 0	0½	
7.	Coal 0	3	
8.	Bone 0	1	
9.	Coal 4	6	8 3¼
10.	Shale, gray.		

"Tidal elevation, 756′, spirit level; principal office, Fairmont; daily capacity, 600 tons; 134 laborers and 105 miners employed; rope and electric haulage; used for steam; shipped west; butts, N. 77°, 30′ W.; faces, N. 12°, 30′ E.; greatest rise, southeast; sample collected for analysis from Nos. 3, 4, 5, 6, 7 and 9 of section in Main Dip Air-course by D. B. Reger; J. J. Brennen, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 613.

Pat Hoge Mine.—No. 34 on Map II.

Located in Fairmont; **Pittsburgh coal.**

		Feet.	Inches.
1.	Coal, roof, left up		
2.	Coal .....2′ 8 ″		
3.	Band, 1½″ to 0 1		
4.	Coal 0 6		
5.	Band 0 0½		
6.	Coal 4 2	7	5½
7.	Slate.		

"Principal office, Fairmont; daily capacity, 20 tons; 5 men employed; used for local domestic fuel; butts, N. 78° W.; faces, N. 12° E.; greatest rise, southeast; sample collected from mining section by Ray V. Hennen."

Consolidation Coal Co. No. 56 (Gaston) No. 35 on Map II.

Located at Gaston; **Pittsburgh coal.**

		Feet.	Inches
1.	Head coal		
2.	Coal .....2′ 1½″		
3.	Bone 0 1		
4.	Coal 0 2		
5.	Bone 0 0¼		
6.	Coal 0 3½		
7.	Bone 0 0½		
8.	Coal 4 4	7	0¾
9.	Shale, gray.		

"Tidal elevation, 895′, spirit level; principal office, Fairmont; daily capacity, 1000 tons; 105 laborers and 70 miners employed; electric and rope haulage; used for steam; shipped west; butts, N. 77° 30′ W; faces, N. 12°, 30′ E.; greatest rise, southeast; sample collected for analysis from Nos. 2, 4, 6, 7 and 8 in Room No. 20, First Butt off Second North by D. B. Reger; Harry Crane, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 643.

Consolidation Coal Co. No. 26 (New England)—No. 36 on Map II.

Located at New England; **Pittsburgh coal.**

		Feet.	Inches.
1.	Draw slate		
2.	Coal, head .....0′ 10 ″		
3.	Coal 2 0½		

				Feet.	Inches.
4.	Bone	0	1		
5.	Coal	0	3		
6.	Bone	0	0¾		
7.	Coal	0	3		
8.	Bone	0	0¾		
9.	Coal	4	5½	8	0½

10. Shale, gray.

"Tidal elevation, 936', spirit level; principal office, Fairmont; daily capacity, 1200 tons; 75 laborers and 80 miners employed; electric haulage; used for steam and domestic fuel; shipped in all directions; butts, N. 77° 30' W.; faces, N. 12° 30' E.; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9 inclusive of section in Main Dip Heading by D. B. Reger; H. C. Ash, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 613.

Robinson Bros., James Mine.—No. 37 on Map II.

Located 1½ miles northeast of Kingmont; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw slate				
2.	Coal	1′	4 ″		
3.	Bone	0	0½		
4.	Coal	0	2¼		
5.	Bone	0	0¼		
6.	Coal	4	0	6	7

7. Shale, gray.

"Tidal elevation, 1097', hand level; principal office, Fairmont; mine just starting. (Nov. 25, 1911) and no tonnage developed; horse haulage; used for local domestic fuel; butts, N. 77° 30' W.; faces, N. 12° 30' E.; greatst rise, southeast; sample collected for analysis from Nos. 2, 3, 4, 5 and 6 of section in Main Heading, 300 feet underground, by D. B. Reger; J. C. McClay, foreman, authority for data."

Virginia & Pittsburgh Coal & Coke Co., Kingmont Mine.—No. 38 on Map II.

Located at Kingmont: **Pittsburgh coal.**

				Feet.	Inches.
1.	Head coal				
2.	Coal	2′	2 ″		
3.	Bone	0	0⅞		
4.	Coal	0	6½		
5.	Bone	0	1		
6.	Coal	4	2	7	0⅜

7. Shale, gray.

"Tidal elevation, 964', hand level; principal office, Kingmont (Fairmont P. O.); daily capacity, 1000 tons; 124 laborers and 176 miners employed; rope and electric haulage; used for gas, by-product coke, and domestic fuel; shipped east; butts, N. 75° W.; faces, N. 15° E.; greatest rise, southeast; sample collected for analysis from Nos. 2, 3, 4 and 6 of section in No. 13 Butt Left by D. B. Reger; Samuel R. Hite, assistant treasurer, authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 643.

This Company has 69 bee-hive coke ovens, of which 36 are in operation (Jan. 21, 1913). A sample of 72-hour coke collected here by Reger gives the following analysis, according to Hite and Krak.

	Per Cent.
Moisture	0.04
Volatile Matter	0.72
Fixed Carbon	89.01
Ash	10.23
Total	100.00
Sulphur	1.46
Phosphorus	0.049

Phillips Coal Co. Mine.—No. 39 on Map II.

Located ½ mile west of Benton Ferry; **Pittsburgh coal.**

		Feet.	Inches.
1.	Slate, black		
2.	Coal .....3'	2 "	
3.	Bone 0	0½	
4.	Coal 0	2½	
5.	Bone 0	0¾	
6.	Coal 0	3	
7.	Bone 0	1	
8.	Coal 4	4½	8 2¼
9.	Shale, gray.		

"Tidal elevation, 1100'. Aneroid; principal office, Fairmont; daily capacity, 150 tons; 6 laborers and 14 miners employed; horse haulage and gravity cable across Tygart Valley river; used for steam; shipped north; butts, N. 77° 30' W.; faces, N. 12° 30' E.; greatest rise, southeast; sample collected for analysis from Nos. 2, 3, 4, 5, 6, and 8 of section in Room No. 2, Second Left Heading, by D. B. Reger; Russell Wilt, foreman authority for data."

Consolidation Coal Co. No. 43 (Monongah No. 6)—No. 40 on Map II.

Located at Monongah; Pittsburgh coal.

				Feet.	Inches.
1.	Slate, black				
2.	Coal, bony	1′	0 ″		
3.	Coal	2	7		
4.	Bone	0	0¾		
5.	Coal	0	2		
6.	Bone	0	0½		
7.	Coal	0	2½		
8.	Bone	0	0½		
9.	Coal	4	1	8	2¼
10.	Shale, gray.				

"Tidal elevation, 829′, spirit level; owned by J. N. Camden estate; principal office, Fairmont; daily capacity, 700 tons; 128 laborers and 100 miners employed; electric haulage; used for steam and domestic fuel; shipped east and west; butts N 71° 30′ W; faces N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9 inclusive of section in Room No. 13 of 6th Left off 2nd North by D. B. Reger; T. R. Barber, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 643.

Consolidation Coal Coal Co. No. 22 (Monongah No. 7)—No. 41 on Map II.

Located ¼ mile south of Monongah; Pittsburgh coal.

				Feet.	Inches.
1.	Draw slate				
2.	Coal, head	0′	8 ″		
3.	Coal	1	11		
4.	Bone	0	0½		
5.	Coal	0	2½		
6.	Bone	0	0½		
7.	Coal	0	3½		
8.	Bone	0	0¾		
9.	Coal	4	6½	7	9¼
10.	Shale, gray.				

"Tidal elevation, 859′, spirit level; owned by J. N. Camden estate; principal office, Fairmont; tonnage and labor included under Monongah No. 5; electric haulage; used for steam; shipped east and west; butts, N 77° 30′ W; faces, 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9 inclusive of section in Main Heading, by D. B. Reger; G. E. Peddicord, Supt., authority for data."

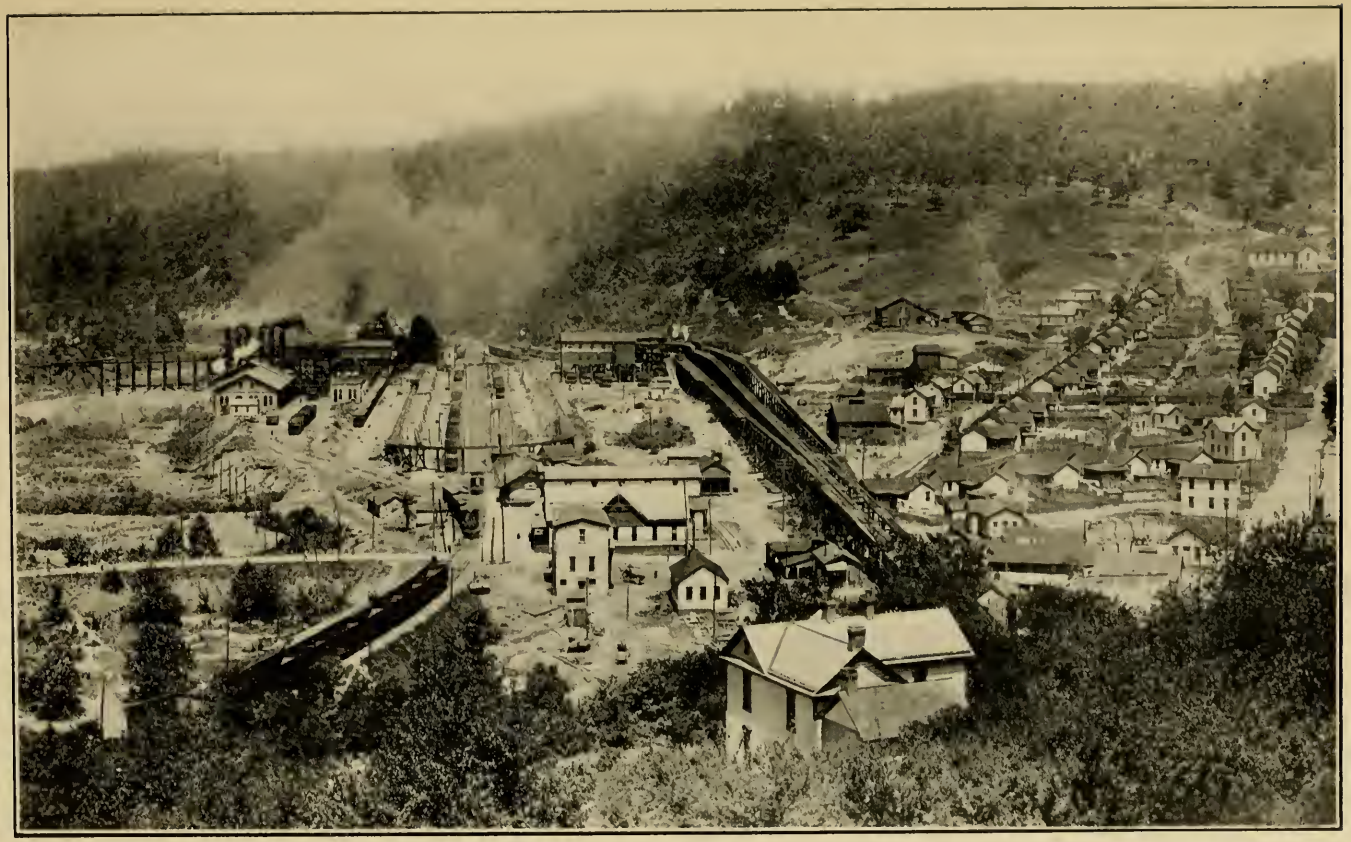

PLATE XXXI.—View of Monongah, Marion County, showing coal handling plant of the Consolidation Coal Company. Topography of the Monongahela Series. The Waynesburg Sandstone at the base of the Dunkard shows at several points along the ridge.

Consolidation Coal Co. No. 22 (Monongah No. 5)—No. 42 on Map II.

Located 1 mile southeast of Monongah; **Pittsburgh coal.**

		Feet.	Inches.			
1.	Draw slate					
2.	Coal, head, bony	0′	10 ″			
3.	Coal, good	2	3½			
4.	Bone	0	1			
5.	Coal	0	2½			
6.	Bone	0	0½			
7.	Coal	0	3			
8.	Bone	0	0¾			
9.	Coal, good	4	1	.....	7	10¼
10.	Shale, gray.					

"Tidal elevation, 899′, spirit level; owned by J. N. Camden estate; principal office, Fairmont; daily capacity, 700 tons; 25 laborers and 85 miners employed; electric haulage; used for steam; shipped east and west; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3, 5, 7 and 9 of section in Room No. 5, Third Face off Second Left by D. B. Reger; G. E. Peddicord, Supt., authority for data."

Consolidation Coal Co. No. 53 (Shaver Nos. 1 and 2)—No 43 on Map II.

Located 1½ miles southeast of Monongah; **Pittsburgh coal.**

		Feet.	Inches.			
1.	Slate, black					
2.	Bone coal	0′	2 ″			
3.	Coal	2	2			
4.	Bone	0	0½			
5.	Coal	0	2½			
6.	Bone	0	0½			
7.	Coal	0	3			
8.	Bone	0	0¾			
9.	Coal	4	5	.....	7	4¼
10.	Shale, gray.					

"Tidal elevation, 964′, spirit level; principal office, Fairmont; daily capacity, 600 tons; 40 laborers and 60 miners employed; electric haulage; used for steam; shipped east and west; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9, inclusive, of section in No. 16 Pillar of First Left by D. B. Reger; mine foreman, authority for data."

Consolidation Coal Co. No. 63 (Monongah No. 8)—No. 44 on Map II.

Located 1 mile southwest of Monongah; **Pittsburgh coal.**

		Feet.	Inches.
1.	Slate, black		
2.	Coal, bony	0′	1 ″
3.	Coal	2	10
4.	Bone	0	0½
5.	Coal	0	2
6.	Bone	0	0½
7.	Coal	0	2½
8.	Bone	0	0½
9.	Coal	4	6
		7	11
10.	Shale, gray.		

"Tidal elevation, 892′, spirit level; principal office, Fairmont; daily capacity, 700 tons; 70 laborers and 90 miners employed; electric haulage; used for steam and coke; shipped east and west; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9, inclusive, of section in Room No. 5, No. 1 Left, Third North, by D. B. Reger; S. S. Davidson, foreman, authority for data."

The Consolidation Coal Company has 99 bee-hive coke ovens, making 4 tons of coke to the run, that use a considerable part of the product of Nos. 63 and 34 (Map Nos. 44 and 45). Samples were collected by Reger of both 48- and 72-hour coke, which show the following analyses, according to Hite and Krak.

	48-hour coke. Per cent.	72-hour coke. Per cent.
Moisture	0.40	0.28
Volatile Matter	1.99	1.39
Fixed Carbon	86.51	87.01
Ash	11.10	11.32
Totals	100.00	100.00
Sulphur	1.15	1.02
Phosphorus	0.041	0.052

No loss on air drying in either sample.

Consolidation Coal Co. No. 34 (Monongah No. 3)—No. 45 on Map II.

Located 1¼ miles southwest of Monongah; **Pittsburgh coal.**

		Feet	Inches.
1.	Slate, dark		
2.	Bone coal	0′	1 ″
3.	Coal	3	0

				Feet.	Inches.
4.	Bone	0	0¾		
5.	Coal	0	3		
6.	Bone	0	0¾		
7.	Coal	0	2½		
8.	Bone	0	0½		
9.	Coal	4	3	7	11½
10.	Shale, gray.				

"Tidal elevation, 896', spirit level; principal office, Fairmont; daily output, 250 tons; 30 laborers and 33 miners employed; electric haulage; used for coke, steam, gas and steel purposes; shipped in all directions; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9 inclusive, of section in Chain Pillar of Sixth Left Heading, by D. B. Reger; J. B. Simons, outside foreman, authority for data."

A former analysis of coal from this mine was published in Vol II(A), W. Va. G. S., page 643. The coal shows a lower percentage of sulphur than any other Pittsburgh mine sampled by the Survey in Monongalia, Marion or Taylor counties.

Consolidation Coal Co. No. 68 (Pennois)—No. 46 on Map II.

Located at Everson; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw slate				
2.	Coal	2′	6 ″		
3.	Bone	0	0½		
4.	Coal	0	2½		
5.	Bone	0	0½		
6.	Coal	0	2½		
7.	Bone	0	0½		
8.	Coal	4	6	7	6½
9.	Shale, gray.				

"Tidal elevation, 910', spirit level; principal office, Fairmont; daily capacity, 525 tons; 37 laborers and 75 miners employed; horse haulage; used for steam, coke and gas; shipped east and west; butts, N 77° 45′ W; faces, N 12° 15′ E; greatest rise, southeast; sample collected for analysis from Nos. 2 to 8, inclusive ,of section in Main Heading between 6th and 7th Left Butt, by D. B. Reger; A. K. Parsons, foreman, authority for data."

A former analysis of coal from this mine was published in Vol. II(A), W. Va. G. S., page 643. This coal is very low in sulphur.

Harry B. Clark Coal Co., Mine No. 6.—No. 47 on Map II.

Located ¾ mile north of Kilarm; Pittsburgh coal.

		Feet.	Inches.
1.	Slate, black		
2.	Head coal, bony....0′	6 ″	
3.	Coal 2	3	
4.	Bone 0	0¾	
5.	Coal 0	2½	
6.	Bone 0	0½	
7.	Coal 0	3	
8.	Bone 0	0¾	
9.	Coal 4	0½ 7	5
10.	Shale, gray.		

"Tidal elevation, 996′, spirit level; principal office, Fairmont; daily capacity, 200 tons; 14 laborers and 25 miners employed; horse haulage; used for steam; shipped east; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3, 4, 5, 6, 7 and 9 of section in Second Right Heading, by D. B. Reger; H. C. Sanders, foreman, authority for data."

Harry B. Clark Coal Co., Mine No. 3.—No. 48 on Map II.

Located 1 mile north of Kilarm; Pittsburgh coal.

		Feet.	Inches.
1.	Draw slate		
2.	Head coal....0′	6 ″	
3.	Coal 2	3½	
4.	Bone 0	0½	
5.	Coal 0	2	
6.	Bone 0	0¾	
7.	Coal 0	3	
8.	Bone 0	1	
9.	Coal 3	10 7	2¾
10.	Shale, gray.		

"Tidal elevation, 970′, aneroid; principal office, Fairmont; not in operation (Nov. 22, 1911); butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3, 4, 5, 6, 7 and 9 of section in Right Crosscut of Straight Heading by D. B. Reger; H. C. Sanders, foreman, authority for data."

Harry B. Clark Coal Co., Mine No. 2.—No. 49 on Map II.

Located ¾ mile north of Kilarm; Pittsburgh coal.

		Feet.	Inches.
1.	Bone coal		
2.	Coal ....2′	2½″	
3.	Bone 0	0¾	
4.	Coal 0	3	
5.	Bone 0	0½	

				Feet.	Inches
6.	Coal	0	3		
7.	Bone	0	1		
8.	Coal	1	11		
9.	Bottom coal	0	3	5	0¾
10.	Shale, gray.				

"Tidal elevation, 970', aneroid; principal office, Fairmont; daily capacity, 30 tons; 1 laborer and 5 miners employed; horse haulage; used for steam; shipped east; butts, N 77° 30' W; faces, N 12° 30' E; greatest rise, southeast; sample collected for analysis from Nos. 2, 3, 4, 5, 6 and 8 of section in slab on Main Heading; H. C. Sanders, foreman, authority for data."

Kilarm Coal & Coke Co., Mine No. 2.—No. 50 on Map II.

Located ⅛ mile north of Kilarm; **Pittsburgh coal.**

				Feet.	Inches.
1.	Slate				
2.	Wild coal	0'	8 "		
3.	Draw slate	0	10		
4.	Head coal	1	3		
5.	Coal	1	8		
6.	Bone	0	1		
7.	Coal	0	2½		
8.	Bone	0	0¾		
9.	Coal	0	3½		
10.	Bone	0	0½		
11.	Coal	2	1½	7	2¾
12.	Shale, gray.				

"Tidal elevation, 980', aneroid; principal office, Kilarm; daily capacity, 250 tons; not in operation (Nov. 22, 1911); horse haulage; used for steam; shipped east and west; butts, N 80° 34' W; faces, N 9° 26' E; greatest rise, S 23° 30' E; sample collected for analysis from Nos. 5, 7, 9, 10 and 11 of section in Room No. 5, Second Left Heading, by D. B. Reger; C. E. Zeek, Supt., authority for data."

Kilarm Coal & Coke Co., Mine No. 1.—No. 51 on Map II.

Located ¼ mile south of Kilarm; **Pittsburgh coal.**

				Feet.	Inches.
1.	Slate, black				
2.	Head coal	1'	3 "		
3.	Coal	1	8		
4.	Bone	0	1		
5.	Coal	0	2		
6.	Bone	0	0½		
7.	Coal	0	3		
8.	Bone	0	0½		
9.	Coal	4	2	7	8
10.	Shale.				

"Tidal elevation, 1025', aneroid; principal office, Kilarm; daily capacity, 250 tons; not in operation (Nov. 22, 1911); electric haulage; used for steam; shipped east and west; butts, N 80° 34' W; faces, N 9° 26' E; greatest rise, S 23° 30' E; sample collected for analysis from Nos. 3 to 9, inclusive, of section in Second Right Heading by D. B. Reger; C. E. Zeek, Supt., authority for data."

This mine was not in operation, owing to the presence of an extensive shale horseback that in places cuts the coal down to a thickness of only 1½ feet. This feature is unusual, as no other mine in the Pittsburgh coal in the territory of this report contains anything like it.

Consolidation Coal Co. No. 59 (Anderson)—No. 52 on Map II.

Located 0.1 mile north of Highland; **Pittsburgh coal.**

		Feet.	Inches.	Feet.	Inches.
1.	Draw slate				
2.	Coal, bony	0'	3 "		
3.	Coal	2	4½		
4.	Bone	0	1		
5.	Coal	0	2		
6.	Bone	0	0¾		
7.	Coal	0	4½		
8.	Bone	0	0¾		
9.	Coal	4	0	7	4½
10.	Shale, gray.				

"Tidal elevation, 930', spirit level; principal office, Fairmont; daily capacity, 150 tons; 9 laborers and 12 miners employed; electric haulage; used for steam; shipped east and west; butts, N 74° W; faces, N 16° E; greatest rise, southeast; sample collected for analysis from Nos. 3, 5, 7 and 9 of section in Second Right Heading, off Fourth Left Face, by D. B. Reger; Walter Neely, outside foreman, authority for data."

Consolidation Coal Co. No. 36 (Highland)—No. 53 on Map II.

Located 0.1 mile south of Highland; **Pittsburgh coal.**

		Feet.	Inches.
1.	Slate, black		
2.	Wild coal	0'	8 "
3.	Draw slate	0	10
4.	Head coal	0	10
5.	Coal, good	1	10
6.	Bone	0	1
7.	Coal	0	3½
8.	Bone	0	0½
9.	Coal	0	3½

				Feet.	Inches.
10.	Bone	0	0¾		
11.	Coal, good	3	7	8	6¼

12. Shale, gray.

"Tidal elevation, 927', aneroid; principal office, Fairmont; daily capacity, 1200 tons; 100 laborers and 90 miners employed; electric and mule haulage; used for steam; shipped east and west; headings run S 48° 48′ E, quartering with the butts of the coal which are N 77° 30′ W; faces N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 5, 7, 9 and 11 of section in Room No. 3, Fifth Left Heading, by D. B. Reger; Walter Neely, outside foreman, authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 643.

Consolidation Coal Co. No. 47 (Middleton).—No. 54 on Map II.

Located ½ mile south of Chiefton; **Pittsburgh coal.**

				Feet.	Inches.
1.	Wild coal	0′	8 ″		
2.	Shale, gray	1	0		
3.	Coal, bony	0	5		
4.	Coal	2	6½		
5.	Bone	0	1		
6.	Coal	0	5		
7.	Bone	0	0¾		
8.	Coal	0	3½		
9.	Bone	0	0½		
10.	Coal	4	1½	9	7¾

11. Shale, gray.

"Tidal elevation, 925', spirit level; principal office, Fairmont, daily capacity, 600 tons; 60 laborers and 40 miners employed; electric and mule haulage; used for steam; shipped west; butts N 77° 30′ W; faces N 12° 30′ E; greatest rise southeast; sample collected from Nos. 4, 6, 7, 8, 9 and 10 of section, in Third Face Heading, by D. B. Reger; T. R. Reed, outside foreman, authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 643.

Consolidation Coal Co. No. 28 (Chiefton)—No. 55 on Map II.

Located at Chiefton; **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, massive			..	..
2.	Shale, gray			1	2
3.	Wild coal, slaty	1′	3 ″		
4.	Shale, gray	0	5		
5.	Coal, bony	0	6		

		Feet.	Inches.		Feet.	Inches.
6.	Coal	2	10			
7.	Bone	0	0¾			
8.	Coal	0	3			
9.	Bone	0	0¾			
10.	Coal	0	3			
11.	Bone	0	0½			
12.	Coal	4	2	.....	9	10

13. Shale, gray

"Tidal elevaton, 896', spirit level; principal office, Fairmont; daily capacity, 700 tons; output, 375 tons; 50 laborers and 40 miners employed; electric haulage; used for steam and domestic fuel; shipped east and west; butts N 77° 30' W; faces N 12° 30' E; greatest rise northeast; sample collected for analysis from Nos. 6, 8, 10 and 12 of section in Room No. 9, No. 11 Left Heading, by D. B. Reger; U. S. Stafford, outside foreman, authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 643.

Consolidation Coal Co. No. 84 (Paradise)—No. 56 on Map II.

Located ¼ mile north of Hutchinson; **Pittsburgh coal.**

		Feet.	Inches.		Feet.	Inches.
1.	Head coal					
2.	Coal	1'	7 "			
3.	Bone	0	0¾			
4.	Coal	0	3			
5.	Bone	0	1			
6.	Coal	0	4			
7.	Bone	0	0¾			
8.	Coal	4	3	.....	6	7½

9. Slate, black.

"Tidal elevation, 836', spirit level; principal office, Fairmont; daily capacity, 100 tons; mine is just being opened (Nov. 13, 1911) and capacity will soon be much greater; 74 men employed; chain and horse haulage; used for steam; shipped east and west; greatest rise, southeast; sample collected for analysis from Nos. 2, 3, 4, 6 and 7 of section in North Airway No. 2, by D. B. Reger; K. D. Bailey, Supt., authority for data."

Consolidation Coal Co. No. 67 (Hutchinson)—No. 57 on Map II.

Located at Hutchinson; **Pittsburgh coal.**

		Feet.	Inches
1.	Sandstone, massive		
2.	Wild coal	0'	10 "
3.	Slate, gray, 0" to	1	3
4.	Head coal	1	0
5.	Coal	1	5

		Feet.	Inches.
6.	Bone 0	0½	
7.	Coal 0	7	
8.	Bone 0	0¾	
9.	Coal 4	4 9	6¼

10. Shale, gray.

"Total elevation, 865', spirit level; principal office, Fairmont; daily capacity, 500 tons; 40 laborers and 45 miners employed; horse haulage to foot of slope; used for steam; shipped west; butts, N 77° 30' W; faces, N 12° 30' E; greatest rise, southeast; sample collected from Nos. 5 to 9, inclusive, of section, in Room No. 10, 5th Butt Entry, by D. B. Reger; K. D. Bailey, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 643.

The Four States Coal & Coke Company has recently begun the operation of a large tract of low sulphur coal in Lincoln district, Marion county. Owing to the isolation of the mine, being the most western operation in the territory of this report, three separate samples were taken. The coal in this region is about 300 feet below drainage and is reached by shafting.

Four States Coal & Coke Co., Annabelle No. 1 Mine—No. 58 on Map II.

Located at Annabelle; **Pittsburgh coal.**

		Feet.	Inches.
1.	Head coal.....		
2.	Coal .....1'	9 "	
3.	Bone 0	0⅜	
4.	Coal 0	7	
5.	Bone 0	1	
6.	Coal 4	0	
7.	Bottom coal.....0	4 6	9⅜

8. Shale, gray.

'Tidal elevation, 746', spirit level; principal office, Frick Bldg., Pittsburgh, Pa.; daily capacity, 1800 tons; 75 laborers and 200 miners employed; compressed air haulage; used for steam, gas, coke and domestic purposes; shipped east and west; butts N 78° W; faces, N 12° E; greatest rise, S 54° E; first sample collected from Nos. 2, 3, 4 and 6 of section in No. 2 Butt East, Left Rise, by D. B. Reger; E. F. Miller, Supt., authority for data."

Four States Coal & Coke Co., Annabelle No. 1 Mine—No. 58 on Map II.

Located at Annabelle; **Pittsburgh, coal.**

		Feet.	Inches.
1.	Slate, black		
2.	Head coal.....1′ 0 ″		
3.	Coal 0 11		
4.	Bone 0 0½		
5.	Coal 0 7		
6.	Bone 0 1		
7.	Coal 4 4		
8.	Bottom coal.....0 4	7	3½
9.	Shale, gray.		

Second sample collected from Nos. 3, 4, 5, 6 and 7 in Room No. 5, No. 1 Butt East, by D. B. Reger.

Four States Coal & Coke Co., Annabelle No. 1 Mine—No. 58 on Map II.

Located at Annabelle; **Pittsburgh coal.**

		Feet.	Inches.
1.	Head coal		
2.	Coal .....2′ 2½″		
3.	Bone 0 0½		
4.	Coal 0 2		
5.	Bone 0 0¼		
6.	Coal 0 4		
7.	Bone 0 0¾		
8.	Coal 4 3		
9.	Bottom coal.....0 6	7	7
10.	Shale, gray.		

"Third sample collected from Nos. 2, 3, 4, 5, 6 and 8 of section in Left Main Dip Aircourse by D. B. Reger."

Lying in the Ligonier Syncline and entirely separated from the coal of the Monongahela Valley by the Chestnut Ridge Anticline, from the summit of which the Monongahela series has been eroded, is a large body of Pittsburgh coal in Taylor county. The coal in this basin has some marked difference from that of the Monongahela Valley. At the top there is usually only 2 to 3 inches of slaty coal that is perceptibly different from the rest of the seam. This feature makes it desirable to mine it almost to the draw slate instead of leaving a foot of coal in place for the roof, as is done along the Monongahela. The bands of bone at the middle of the seam are not regarded with such disfavor as they are elsewhere, and are often shipped with the remainder of the coal.

No. on Map	Name of Well	Location	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
453	A. J. Hayes No. 13..	Rymer, 0,7 m. N 80° E.....	1025B	628	5
460	Jonathan Arnett No. 1.....	Curtisville, 0.5 m. NW	1055B	714	..
462	W. N. Cunningham No. 4.....	Curtisville, 1.3 m. N 85° W...	1075B	804	5
464	Jacob Cunningham No. 9.....	Curtisville, 1.4 . m. S 75° W...	1070B	800	5
465	Jacob Cunningham No. 3.....	Curtisville, 1.8 m. S 70° W...	1155B	935	..
469	Alexander Huey No. 1.....	Curtisville, 1.3 m. S.....	....	722	8
471	M. W. Huey Heirs No. 1.....	Pleasantville, 2.4 m. NW.....	1320B	860	5
472	J. A. Harbert No. 1..	Pleasantville, 2.4 m. NW	1085B	630	4
472A	Geo. A. Huey No. 1..	Pleasantville, 2.5 m. NW	1350B	870	..
487	Daniel Varner No. 1.	Condit, 1.8 m. N 80° E.....	1155B	610	..
489	Columbus Snodgrass No. 1.....	Condit, 1.4 m. E.	1060B	510	5
490	Thornton Fluharty No. 1.....	Condit, 1.1 m. SE	1055B	475	..
498	James Fluharty No. 1.....	Mannington, 2.4 m. N 25° E...	1305B	714	..
499	E. Wilson No. 1....	Mannington, 2.4 m. N 30° E...	1180B	595	..
501	Ozias Kuhn No. 1..	Mannington, 2 m. N 30° E...	....	585	..
502	B. F. Blackshere No. 15.....	Downs, 0.6 m. NW	1250B	530	..
536	Lindsay Blaker No. 1	Pleasantville, 0.7 m. NE	1115B	328	2
541	Fleming Hamilton No. 1.....	Mannington, 0.5 m. S.....	1055B	345	12
555	Brice Wallace No. 1.	Fairview, 1 m. NE	1025B	420	10
556	David Jones No. 5..	Fairview, 0.9 m. N. 10° W.....	....	595	7
574	U. G. King No. 1791.	Fairview, 1.8 m. SE	972L	140	..
577	Ulysses M. Price No. 1.....	McCurdyville, 1.1 m. SE.....	....	711	..
585	J. W. Williams No. 1.	Arnettsville, 1.4 m. W.....	1199L	390	5
591	Wm. Wallace No. 1.	Fairview, 2.1 m. SW	1110B	470	10
597	A. O. Talkington No. 7.....	Downs, 1.5 m. N	1105B	410	..
599	Rezin Amos No. 1...	Downs, 1.3 m. N	1117L	380	7

No. on Map	Name of Well	Location	Elevation of Well Mouth A. T.	Depth Feet	Thickness Feet.
600	L. D. Martin No. 1..	Downs, 1.2 m. NE	....	550	..
621	Morgan-Fox core test No. 14.....	Farmington, 0.5 m. N.....	998L	209	6
623	Jessie B. Martin core test No. 10...	Farmington, 1.4 m. SW.....	936L	118.5	5
625	E. T. Wood core test No. 3.....	Downs, 1.3 m. SE	974L	174.5	5
628	D. C. Jones No. 2449.	Annabelle, 2.2 m. NW	1245B	499	5
629	H. R. Glover No. 1885	Annabelle, 2.2 m. N 70° W...	1210B	445	5
634A	Absalom Martin core test No. 1...	Festus, 2 m. NW	1122L	315	5
635	A. A. Parrish No. 805	Annabelle, 1 m. N 35° E.....	1285B	480	6
639	W. S. Parrish No. 2197.....	Festus, 0.7 m. N 30° W.....	1240B	453	4
639A	Olive Minnear core test No. 2.....	Festus, 0.8 m. NW	1007L	138.5	6
640	A. Martin No. 2165..	Annabelle	1155B	280	5
640A	Jane Downs core test No. 4.....	Annabelle, 0.4 m. NW.....	1064L	207	6.2
641	Mattie C. Sturm No 1.....	Sturms Mill, 0.8 m. N.....	1035B	60	..
642	E. H. Stephens No. 2138.....	Sturms Mill, 0.5 m. E.....	1033L	70	3
646	Z. F. Davis core test No. 4.....	Worthington, 1.3 m. N.....	965L	68.5	6
647	W. P. Fortney core test No. 3.....	Worthington, 1 m. NW.....	918L	47.5	6
651	Marvin Tetrick (E. Straight) No. 2148.	Worthington, 1.4 m. W.....	1220B	348	..
652	Nancy Billingsley core test No. 5...	Hutchinson, 0.5 m. NW.....	994L	80	0.3
653	Wm. F. Sandy core test No. 12.....	Hutchinson, 0.5 m. W.....	1101L	155	2.2
654	J. L. Davis core test	Farmington, 0.7 m. E.....	923L	115	6.3
655	Curtis Fletcher core test No. 9.....	Farmington, 1 m. E.....	918L	82	5.7
659	Nancy Martin core test No. 6.....	Monongah, 1.4 m. NW.....	998L	95	6.5
665	Lewis Hall No. 1...	Barrackville, 1.4 m. N 20° W...	1065B	300	5
669	Morgan-Billingslee core test No. 8....	Barrackville, 1.8 m. W.....	914L	89.5	9.5
672	Shore core test No. 7	Fairmont, 1 m. NW	984L	150	5.5

With the information contained in the foregoing table and with observations made at outcrop which show that the Sewickley coal is not found east of the Monongahela river, except in a small tract in Union district, Monongalia county, the following estimates have been made by Reger, using an average thickness of 4.5 feet and making a slight assumption regarding the outcrop, as explained in the table:

Available Sewickley Coal West of Monongahela River.

Planimeter formula:

Sewickley coal equals Pittsburgh coal minus outcrop of same in miles multiplied by 0.1.

Counties by Districts.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons. of Coal.
Monongalia:				
Batteile	56.40	36,096	7,075,537,920	283,021,517
Clay	63.49	40,634	7,965,076,680	318,631,067
Cass	28.04	17,946	3,517,774,920	140,710,997
Grant	32.23	20,627	4,043,304,540	161,732,182
Totals	180.16	115,303	22,601,694,060	904,095,763
Marion:				
Mannington	100.09	64,058	12,556,649,160	502,265,966
Pawpaw	38.49	24,634	4,828,756,680	193,150,267
Lincoln	56.02	35,853	7,081,905,060	283,276,202
Fairmont	19.29	12,346	2,420,062,920	96,802,517
Totals	213.89	136,891	26,887,373,820	1,075,494,952
Totals for area	394.05	252,194	49,489,067,880	1,979,590,715

The Redstone Coal.

The Redstone coal, which overlies the Pittsburgh coal by an interval varying from 20 to 40 feet, is commercially important only in a small portion of Cass and Grant districts, Monongalia county. In all other regions where the horizon crops there is no coal. In the western portions of Monongalia and Marion counties, where its horizon has been pierced by hundreds of oil wells, the coal is nearly always absent. The coal has been mined for local use in the part of Monongalia county mentioned and has given good results, but there are no mines in it now, owing to the more easily available Pittsburgh coal below. The only sample collected from it was at a hillside prospect where mud seams had filtered into the vein, making the analysis show a high percentage of ash and a high oxygen content and a corresponding low heat value. If the

Figure 7.—Showing approximate area of Redstone Coal.

coal is mined it must be done before the Pittsburgh is taken from beneath it, as the intervening strata are too thin to remain in place.

Available Redstone Coal.

The following table shows the only wells that record Redstone coal in the territory of this report.

List of Wells Recording Redstone Coal.

No. on Map.	NAME OF WELL.	LOCATION.	Elevation of Well Mouth. A. T.	Depth. Feet.	Thick ness Feet.
	Monongalia County:				
168	Grant Stephens.....	Mooresville	960B	449	1
211	D. J. Eddy.....	Behler, 0.5 m. S.	1058L	439	1
232	Cal Hawkins No. 1..	Hagans, 0.5 m. E	....	559	4
234	M. A. Miller coal test No. 9.....	Hagans	1010	329	4.1
250	Bowen Wade No. 2..	Bowlby, 0.9 m. N 20° E.....	1190B	382	4
251	Iona Bowlby No. 3..	Bowlby, 0.5 m. NW.	1130B	361	5
267	Mankedick Heirs coal test No. 3.....	Cassville, 0.7 m. E.	963L	136	1.8
273	Elza Davis No. 1....	Maidsville, 1.1 m. W.	1050B	147	5
283	T. A. and J. F. Keenan No. 1.....	Maidsville, 1.2 m. N 50° W.....	1035B	86	4
292	J. H. Cole coal test No. 2.....	Cassville, 2 m. S.	1058L	279	2.2
303	J. N. Michael coal test No. 4.....	Hagans, 1.8 m. NE.	1159L	463	1.2
308	Joseph E. Lynch coal test No. 5.....	Georgeotwn, 1.8 m. N.....	1068L	324	1.7
311	Mary J. Lynch coal test No. 10.....	Arnettsville, 1.8 m. NW.....	980L	236	1
314	A. C. Barker coal test No. 6.....	Georgetown, 1.2 m. NE.....	999L	245	2
315	E. W. Brand coal test No. 1.....	Laurel Point, 1 m. NW.....	1005	188	0.1
	Marion County:				
515	J. W. Conaway No. 3.	Mannington, 2.2 m. SW.....	1064B	472	4
627	James Morgan (Silas Stark) No. 1894...	Annabelle, 1.1 m. NW.	1112L	302	..
643	Mary Hawkins core test No. 13.....	Sturms Mill, 0.6 m. SE.....	946L	43	0.3

By assuming a thickness of 4 feet for the Redstone coal in the region indicated on the figure the following computation and estimate was made by Reger:

Available Redstone Coal.

County.	Square Miles.	Acres.	Cubic Feet. of Coal.	Short Tons of Coal.
Monongalia	11.27	7,212.8	125,675,828	5,027,032

The Pittsburgh Coal.

The Pittsburgh coal, which has been described in Chapter VI, is the most valuable single mineral resource of the territory of this report. Being of greater purity than the Sewickley and of greater regularity than the Redstone it has been mined much more extensively than these coals. Since it underlies them both by a short interval it is quite probable that these two coals will be greatly injured and in places rendered unavailable for mining unless greater care is taken to protect them. The intervening strata are generally too thin and unstable to remain in place after the Pittsburgh coal has been removed.

In the region of Monongalia and Marion counties, west of the present mining zone, but little is known concerning the chemical character of the coal. A sample was collected from the bailer by the driller of the T. W. Kinnan (20) gas well in Battelle district, Monongalia county, the analysis of which is published in the table at the end of this chapter. Whether the coal in the region mentioned is of a suitable character for coke manufacture is a question that cannot be answered until core tests have been made.

Of the commercial mines all were sampled for analysis, one sample being usually taken, the only exceptions being at some of the larger shaft operations in Marion county, where additional samples were thought necessary. The Table of Coal Analyses at the end of this chapter shows the results of this work. Since there are commercial mines in nearly all localities where the coal crops only one sample was taken from a farm mine, this one being located near Stewartstown, Monongalia county, where there is no commercial mine. The samples of the commercial mines were taken according to the methods advocated by the U. S. Bureau of Mines and the analyses were made by standard methods in the Survey labora-

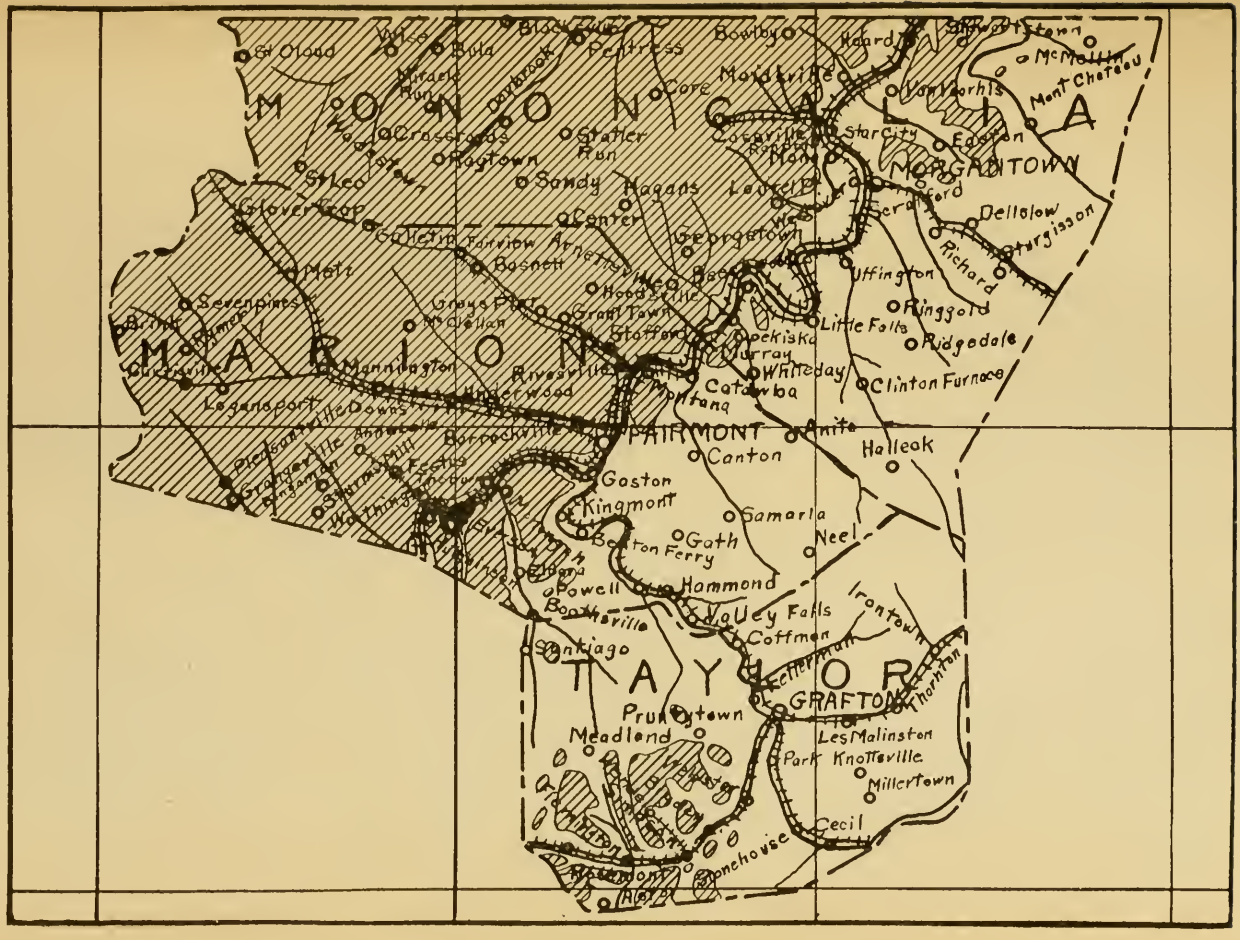

Figure 8.—Showing area of Pittsburgh Coal.

tory. The detailed descriptions of the mines, giving a carefully measured section at the working face where the sample was taken in each mine, are published in the following pages.

Wm. Robinson Farm Mine—No. 16 on Map II.

Located ¼ mile south of Stewartstown; **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, massive, Pittsburgh			35	00
2.	Coal, very slaty	1′	3 ″		
3.	Coal, slaty	1	8		
4.	Coal	0	5		
5.	Slate	0	1		
6.	Coal	2	0		
7.	Slate	0	0¼		
8.	Coal	0	9		
9.	Slate	0	0½		
10.	Coal	4	11	11	1¾
11.	Slate.				

On account of the poor drainage in this mine, the sample was collected from the stock pile at the pit mouth.

Elkins Coal & Coke Co. No. 5 (Fulmer)—No. 17 on Map II.

Located 2 miles northeast of Morgantown; **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, Pittsburgh			25	0
2.	Draw slate			0	6
3.	Coal, breast	1′	8 ″		
4.	Bands	0	6		
5.	Coal, bottom	5	4	7	6

Section republished from Vol. II, W. Va. G. S., page 173; analysis republished from Vol. II(A), page 668.

Great Scott Coal & Coke Co., Great Scott Mine.—No. 18 on Map II.

Located ¼ mile south of Randall; **Pittsburgh coal.**

				Feet.	Inches.
1.	Slate, black				
2.	Coal	0′	3 ″		
3.	Shale, gray	1	6		
4.	Wild coal, hard, bony	0	10		
5.	Shale, gray	0	8		
6.	Coal, good	1	3		
7.	Coal, bony	0	3		
8.	Coal, good	1	0		
9.	Slate, black	0	0½		
10.	Coal	1	6		
11.	Bone	0	0¼		
12.	Coal	0	4½		
13.	Bone	0	0¼		
14.	Coal	4	1	11	9½
15.	Shale, gray.				

"Tidal elevation, 925', aneroid, at new opening; principal office, Morgantown; daily capacity, 500 tons; average output, 50 tons; 2 laborers and 5 miners employed; horse haulage and gravity cable to railroad; used for steam and domestic fuel; shipped east and west; butts, N 69° 30' W; faces N 20° 30' E; greatest rise, southeast; usual sample collected for analysis from Nos. 8, 10, 11, 12, 13 and 14; sample also collected from Nos. 6 and 7 in Room No. 3, First Butt Right, by D. B. Reger; Gordon Tait, Supt., authority for data."

Antler Coal Co., Grant Mine.—No. 19 on Map II.

Located 0.4 mile west of Roundbottom; **Pittsburgh coal.**

		Feet.	Inches.
1.	Draw slate.....		
2.	Coal, head.....0' 8 "		
3.	Coal, good.....1 6		
4.	Slate, black.....0 0½		
5.	Coal 1 8		
6.	Bone 0 0¾		
7.	Coal 3 11	7	2¼
8.	Shale, gray.		

"Tidal elevation, 1168', hand level; principal office, Fairmont; daily capacity, 300 tons; 11 laborers and 40 miners employed; horse haulage and gravity cable to railroad; used for gas, steam and domestic fuel, shipped to lake and local trade; butts N 78° W; faces N 12° E; greatest rise, S 45° E; sample collected from Nos. 3, 5, 6 and 7 in Kirk Heading, by D. B. Reger. Charles Gandy, Supt., authority for data."

Consolidation Coal Co. No. 30 (Beechwood).—No. 20 on Map II.

Located at Beechwood; **Pittsburgh coal.**

		Feet.	Inches.
1.	Draw slate.....		
2.	Coal, bony .....0' 7 "		
3.	Coal, good 0 11		
4.	Slate, black 0 1		
5.	Coal 1 5½		
6.	Bone 0 0½		
7.	Coal 0 2½		
8.	Bone 0 0¼		
9.	Coal 0 2		
10.	Bone 0 0½		
11.	Coal 4 2	7	8¼
12.	Shale, gray.		

"Tidal elevation, 968', spirit level; principal office, Fairmont; daily capacity, 350 tons; 20 laborers and 40 miners employed; electric haulage; used for railroad fuel; shipped east; butts, N 76° 09' W; faces, N 13° 51' E; greatest rise, northeast; sample collected from Nos. 5 to 11, inclusive, of section in No. 2 Pillar on First Left of No. 3 Opening, by D. B. Reger; H. S. Toothman, Supt., authority for data."

A former sample from this mine is published in Vol. II (A), W. Va. G. S., page 643.

Pittsburgh Steam Coal Co., Opekiska Mine.—No. 21 on Map II.

Located ½ mile south of Opekiska; **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, massive				
2.	Coal, bony	0′	11 ″		
3.	Coal	1	8		
4.	Bone	0	0½		
5.	Coal	0	5½		
6.	Bone	0	0¾		
7.	Coal	4	3	7	4¾
8.	Shale, gray				

"Tidal elevation, 1152′, hand level; principal office, Fairmont; daily capacity, 75 tons; 11 laborers and 16 miners employed; horse and rope haulage; used for steam and coke; shipped north; butts, N 78° W; faces, N 12° E; greatest rise, south; sample collected for analysis from Nos. 3 to 7 inclusive, of section in Room No. 5 of No. 4 Butt, by D. B. Reger; Charles Cox, assistant foreman, authority for data."

This company has 19 coke ovens in operation. A sample collected from 48 hour coke by Reger shows the following analysis according to Messrs. Hite and Krak.

	Sample as Received. Per cent.
Moisture	0.28
Volatile Matter	1.47
Fixed Carbon	88.49
Ash	9.76
Total	100.00
Sulphur	1.65
Phosphorus	0.019

"No loss on air drying."

A former sample from this mine was published in Vol. II(A), W. Va. G. S., page 643.

Consolidation Coal Co. No. 45 (Murray)—No. 22 on Map II.

Located at Murray; **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, massive				
2.	Shale, gray	0′	4 ″		
3.	Coal, good, head	1	3		
4.	Coal	2	0		
5.	Bone	0	0½		
6.	Coal	0	5½		
7.	Bone	0	0½		
8.	Coal	4	3	8	4½
9.	Shale, gray.				

"Tidal elevation, 943', spirit level; principal office, Fairmont; daily capacity, 350 tons; 35 laborers and 35 miners employed; rope haulage, steam and electric drive; used for steam; shipped west; butts N 71° 30' W; faces N 18° 30' E; greatest rise, S 54° E; sample collected for analysis from cross heading near pit mouth by D. B. Reger; W. H. Hess, Superintendent, authority for data."

A former sample from this mine was published in Vol. II(A), W. Va. G. S., page 643.

Catawba Coal Co., Catawba Mine.—No. 23 on Map II.

Located ¾ mile southwest of Catawba; Pittsburgh coal.

		Feet.	Inches.
1.	Draw slate.....		
2.	Coal, head.....1' 9 "		
3.	Coal 1 8		
4.	Bone 0 0⅞		
5.	Coal 0 2		
6.	Bone 0 0⅝		
7.	Coal 0 2		
8.	Bone 0 0½		
9.	Coal 4 0	7	11
10.	Shale, gray, soft.		

"Tidal elevation, 1198', hand level; principal office, Connellsville, Pa.; daily capacity, 100 tons; 4 laborers and 12 miners employed; horse haulage; used for domestic fuel; shipped north and west; butts, N 76° W; faces, N 14° E; greatest rise, southeast; sample collected for analysis from Nos. 3, 5, 6, 7, 8 and 9 of section by D. B. Reger; G T. Rodeheaver, Supt., authority for data."

Pittsburgh Steam Coal Co., Elizabeth Mine.—No. 24 on Map II.

Located ¾ mile east of Montana. Pittsburgh coal.

		Feet.	Inches.
1.	Draw slate.....		
2.	Coal, bony, head.....1' 2 "		
3.	Coal 2 0		
4.	Bone 0 1		
5.	Coal 0 2		
6.	Bone 0 0⅞		
7.	Coal 0 2½		
8.	Bone 0 0½		
9.	Coal 4 1	7	9⅞
10.	Shale, gray.		

"Tidal elevation, 985', hand level; principal office, Fairmont; daily capacity, 150 tons; 7 laborers and 17 miners employed; horse haulage; used for steam; butts, N 69° 15' W; faces, N 20° 45' E; greatest rise N. 34° 09' W. Sample collected for analysis from Nos. 3, 5, 7, 8 and 9 of section by D. B. Reger; Eli Stewart, foreman, authority for data."

Virginia & Pittsburgh Coal & Coke Co., Morgan Mine.—No. 25 on Map II.

Located ½ mile east of Montana; Pittsburgh coal.

				Feet.	Inches.
1.	Draw slate				
2.	Coal, head	0′	9 ″		
3.	Coal, good	2	1		
4.	Bone	0	0⅞		
5.	Coal	0	2		
6.	Bone	0	0⅝		
7.	Coal	0	2½		
8.	Bone	0	0¾		
9.	Coal	3	11	7	3¾
10.	Shale, gray.				

"Tidal elevation, 938′, hand level; principal office, Fairmont; daily capacity, 200 tons; 15 laborers and 32 miners employed; mule haulage; used for gas and steam; shipped east; butts, N 78° W; faces, N 12° E; greatest rise, east; sample collected for analysis from Nos. 3 to 9, inclusive, of section in Second Butt by D. B. Reger; M. C. Hite, Supt., authority for data."

Consolidation Coal Co. No. 24 (Montana.)—No. 26 on Map II.

Located at Montana; Pittsburgh coal.

				Feet.	Inches.
1.	Draw slate				
2.	Coal, bony	0′	5 ″		
3.	Coal, good	1	8½		
4.	Bone	0	0½		
5.	Coal	0	6		
6.	Bone	0	0¾		
7.	Coal	0	5½		
8.	Bone	0	0¾		
9.	Coal	3	6	6	9
10.	Shale, gray.				

"Tidal elevation, 869′, spirit level; principal office, Fairmont; daily capacity, 800 tons; 90 laborers and 85 miners employed; rope and electric haulage; used for steam, gas and coke; shipped west; butts, N 77° 30′ W; faces, N 12° 30′ E; greatest rise, southeast; sample collected for analysis from Nos. 3 to 9 inclusive, in No. 9 Butt on Second Level by D. B. Reger; H. M. Smith, Supt., authority for data."

A former sample was published from this mine in Vol. II(A), W. Va. G. S., page 643.

Photo by Ray Bricker.

PLATE XXIX.—Mine of the New Central Coal & Coke Company (No. 28 on Map II) in the Pittsburgh Coal at Stafford, Marion County. Topography of the Monongalia Series.

Federal Coal & Coke Co. Mine.—No. 27 on Map II.

Located at Grant Town; **Pittsburgh coal.**

		Feet.	Inches.
1.	Black slate, roof.....		
2.	Coal .....2′ 6 ″		
3.	Band 0 0¼		
4.	Coal 0 6		
5.	Band 0 0¼		
6.	Coal 3 6		
7.	Coal, bottom 1 0	7	6½
8.	Slate		

"Tidal elevation, 680′, spirit level; principal office, Grant Town; daily capacity, 2000 tons; 250 miners and 150 laborers employed; electric haulage; used for coke and gas; shipped east; butts, N., 77½° W.; faces N. 12½° E.; greatest rise, south; sample collected in Room No. 3, off Fourth East Entry by Ray V. Hennen; regular sample taken from Nos. 2, 3, 4, 5 and 6 of section and additional sample taken from bottom coal. J. W. Devison, Supt., authority for data. Only Nos. 2-6 are mined, No. 7 being left down on account of being high in sulphur, and as a rule this bottom coal is only 6″ to 8″ thick."

The New England Gas & Coke Company of Boston, Mass., which utilizes a large part of the product of this mine, has furnished, through its general manager, Capt. W. E. McKay, the following statistics regarding its use in by-product ovens:

Average yield of coke.....70 per cent of coal.
Average yield of ammonia ($N H_3$).....24 lbs. per net ton of coal.
Average yield of tar .....11½ gal. per net ton of coal.
Average quantity of illuminating gas corrected to 60° F. and 30 in. barometer pressure .....5000 cu. ft. per net ton of coal
British Thermal Units in illuminating gas.640 per cu. ft.
British Thermal Units in fuel gas.....620 per cu. ft.
Average price received for coke .....$3.75 per net ton.
Average price received for ammonia....0.0285 per lb.
Average price received for tar.....0.02675 per gal.

New Central Coal Co., Stafford Mine.—No. 28 on Map II.

Located at Stafford; **Pittsburgh coal.**

		Feet.	Inches.
1.	Slate		
2.	Coal, roof.....1′ 0 ″		
3.	Coal 2 6		
4.	Band 0 0¼		
5.	Coal 0 6		
6.	Band 0 0¼		
7.	Coal 3 8		
8.	Coal, sulphurous, 6″ to....0 8	8	4½
9.	Slate.		

"Tidal elevation, 638', aneroid; principal office, Fairmont; daily capacity, 1500 tons; 275 men employed; compressed air haulage; used for steam and gas; shipped east; butts, N. 77½° W.; faces, N. 12½° E.; greatest rise north; sample collected for analysis from Nos. 3-7, inclusive, of section at working face of No. 2 East Heading by Ray V. Hennen; Nos. 2 and 8 have been objectionable for gas on account of higher sulphur content; G. S. Phillips, Supt., authority for data."

Dakota Coal & Coke Co., Dakota No. 2 Mine—No. 29 on Map II.

Located at Dakota; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw slate				
2.	Roof coal	1′	0 ″		
3.	Coal	2	3½		
4.	Bone	0	1		
5.	Coal	0	2½		
6.	Bone	0	0½		
7.	Coal	0	2½		
8.	Bone	0	0½		
9.	Coal	4	6	8	4½
10.	Shale, gray				

"Tidal elevation, 671', hand level; principal office, Drawer 915, Pittsburgh, Pa.; daily capacity, 275 tons; 38 laborers and 28 miners employed; mule haulage; used for gas; shipped west; butts, N. 76° W.; faces, N. 14° E.; greatest rise, northwest; sample collected for analysis from Nos. 3, 5, 6, 7, 8 and 9 of section in Room No. 2 of No. 2 Butt by D. B. Reger; E. B. Rowe, general superintendent; authority for data."

Jamison Coal & Coke Co. No. 9.—No. 30 on Map II.

Located at James Fork; **Pittsburgh coal.**

				Feet.	Inces.
1.	Draw slate				
2.	Coal, head	1′	4 ″		
3.	Coal	1	8		
4.	Bone	0	0½		
5.	Coal	0	0½		
6.	Bone	0	0¼		
7.	Coal	0	3½		
8.	Bone	0	0½		
9.	Coal	3	10		
10.	Bottom coal	0	8	7	11¼

"Tidal elevation, 681', spirit level; principal office, Oliver Building, Pittsburgh, Pa.; daily capacity, 1000 tons; 75 laborers and 98 miners employed; compressed air haulage; used for gas and coke; shipped east; butts N. 77°, 30′ W.; faces, N. 12°, 30′ E.; stratum is

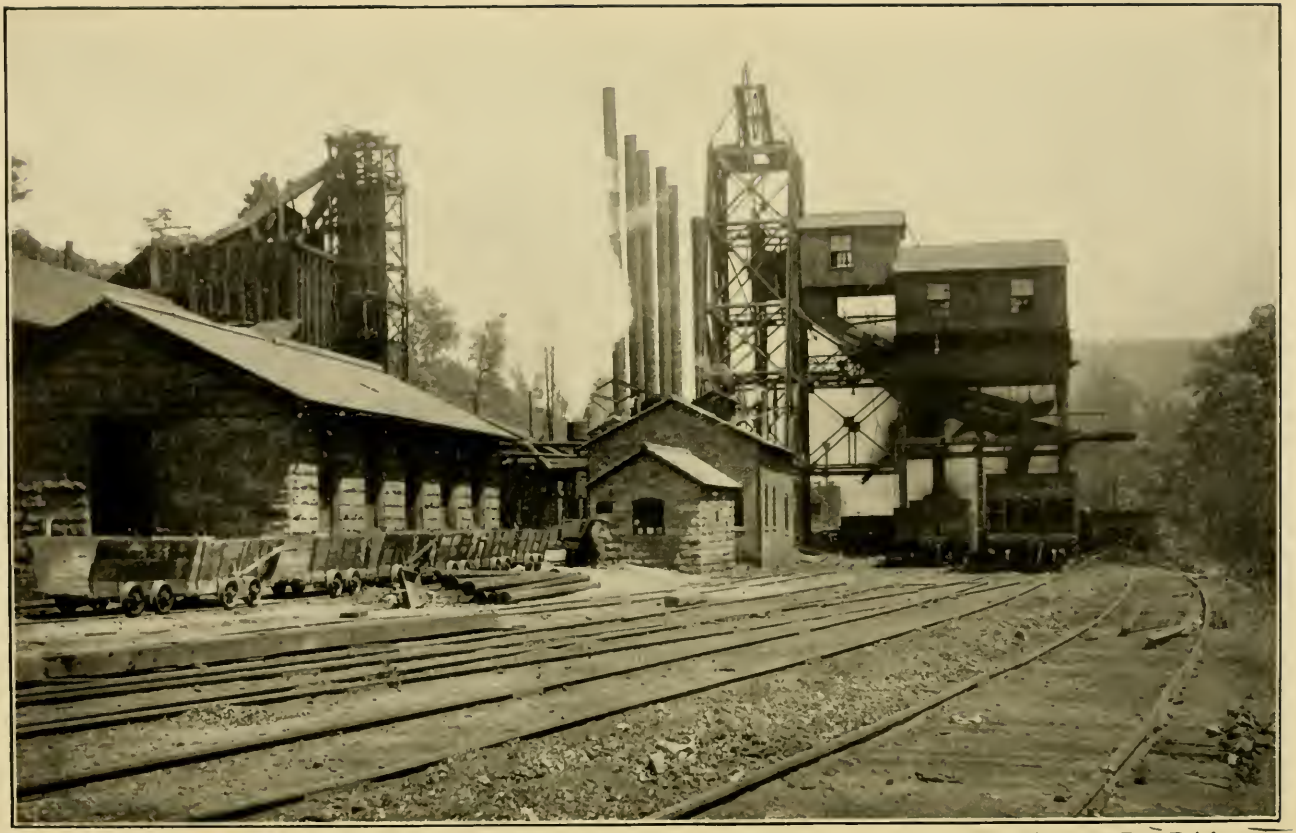

Photo by Ray Bricker.

PLATE XXX.—Mine No. 8 of the Jamison Coal & Coke Co. (No. 31 on Map II) at Underwood, Marion County. Buildings made of Waynesburg Sandstone.

level; first sample collected for analysis from Nos. 3 to 9, inclusive, of section in room No. 1, No. 7 Butt, South A, by D. B. Reger; M. W. Head, general superintendent; G. H. Musgrove, Chief Clerk, authority for data."

Jamison Coal & Coke Co. No. 9.—No. 30 on Map II.

Located at James Fork; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw Slate				
2.	Coal, bony	0′	6 ″		
3.	Coal, head	0	6		
4.	Coal, good	2	1		
5.	Bone	0	0½		
6.	Coal	0	1½		
7.	Bone	0	0¼		
8.	Coal	0	3½		
9.	Bone	0	0½		
10.	Coal	4	8	8	3¼

11. Shale, gray.

"Second sample collected for analysis from Nos. 4 to 10 inclusive, of section in No. 1 Butt off Main North A, by D. B. Reger."

Jamison Coal & Coke Co. No. 8.—No. 31 on Map II.

Located ¾ mile east of Underwood; **Pittsburgh coal.**

				Feet.	Inches.
1.	Head coal				
2.	Coal	1′	10 ″		
3.	Bone	0	0⅝		
4.	Coal	0	5		
5.	Bone	0	1		
6.	Coal	4	0½		
7.	Bottom coal	0	5	6	10⅛

8. Shale, gray.

"Tidal elevation, 681′, spirit level; principal office, Oliver Building, Pittsburgh, Pa.; daily capacity, 2000 tons; 80 laborers and 240 miners employed; compressed air haulage; used for gas, steam, cement burning and coke; shipped east; butts N. 77°, 30′ W.; faces N. 12°, 30′ E: greatest rise north; first sample collected for analysis from Nos. 2, 3, 4, 5 and 6 of section in Room No. 2, 13th Left Extension, off 2nd Right, off 3rd Left, by D. B. Reger; G. H. Musgrove, Chief Clerk, authority for data."

Jamison Coal & Coke Co. No. 8.—No. 31 on Map II.

Located ¾ mile east of Underwood; **Pittsburgh coal.**

		Feet.	Inches.
1.	Head coal		
2.	Coal .....1′ 8″		
3.	Bone 0 0¾		
4.	Coal 0 5		
5.	Bone 0 1		
6.	Coal 4 0	6	2¾
7.	Bottom coal.		

"Second sample collected for analysis from Nos. 2, 3, 4 and 6 of section in Main Heading above 17th Right by D. B. Reger."

This company operates a number of bee-hive coke ovens at this mine, the coal being washed before using. According to the general superintendent, the plant is still in the experimental stage and for that reason no sample was secured for analysis.

Jamison Coal & Coke Co. No. 7.—No. 32 on Map II.

Located 1 mile west of Barrackville; **Pittsburgh coal.**

		Feet.	Inches.
1.	Head coal		
2.	Coal .....2′ 3″		
3.	Bone 0 0¼		
4.	Coal 0 2½		
5.	Bone 0 1		
6.	Coal 0 3		
7.	Bone 0 0¾		
8.	Coal 3 11		
9.	Bottom coal 0 6	7	3½
10.	Shale, gray.		

"Tidal elevation, 665′, spirit level; principal office, Oliver Building, Pittsburgh, Pa.; daily capacity, 1200 tons; 75 laborers and 103 miners employed; compressed air haulage; used for gas and coke; shipped east; butts, N. 77°, 30′ W.; faces, N. 12°, 30′ E.; greatest rise, southeast; first sample collected from Nos. 2, 3, 4, 6, 7 and 8 in No. 2 Heading, Main South A, by D. B. Reger; G. H. Musgrove, Chief Clerk, authority for data."

Jamison Coal & Coke Co. No. 7.—No. 32 on Map II.

Located 1 mile west of Barrackville; **Pittsburgh coal.**

		Feet.	Inches.
1.	Draw slate		
2.	Coal, head .....1′ 0″		
3.	Coal 2 8		

The following sections illustrate the bed section of this coal in the Ligonier basin of Taylor county:

Harrison Coal Co., Tyrconnel Mine—No. 59 on Map II.

Located ½ mile south of Rosemont; **Pittsburgh coal.**

		Feet.	Inches.
1.	Sandstone, massive.....		
2.	Coal, slaty.....0′ 2″		
3.	Coal 2 10		
4.	Bone 0 1		
5.	Coal, good.....4 8	7	9
6.	Shale, gray, hard.		

"Tidal elevation 1331′, hand level; principal office, Meyersdale, Pa., daily capacity, 200 tons; 40 men employed; mule haulage; used for steam and domestic fuel; shipped east and west; butts, N 85° W; faces, N 5° E; greatest rise, northwest; sample collected from Nos. 3, 4 and 5 in Room No. 1, Straight Fairmont Heading, by D. B. Reger; H. G. Smith, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 644.

Rosemont Coal Co., Rosemont Mine—No. 60 on Map II.

Located ½ mile southeast of Rosemont; **Pittsburgh coal.**

		Feet.	Inches.
1.	Sandstone,massive		
2.	Coal, slaty.....0′ 3 ″		
3.	Coal 2 6		
4.	Bone 0 0¾		
5.	Coal 4 1	6	10¾

"Tidal elevation, 1280′, hand level; principal office, Philadelphia, Pa.; daily capacity, 900 tons; 250 men employed; electric and horse haulage; used for steam and domestic fuel; shipped east and west; butts, N 78° 45′ W; faces, N 11° 15′ E; greatest rise, northwest; sample collected for analysis from Nos. 3, 4 and 5 of section in Room No. 22, B-3 Heading, by D. B. Reger; James Stafford, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va. G. S., page 644.

Pittsvein Coal Co., Flemington Mine—No. 61 on Map II.

Located ½ mile northeast of Flemington; **Pittsburgh coal.**

		Feet.	Inches.
1.	Slate, black, hard		
2.	Draw slate	1	0
3.	Coal, slaty 0	3	
4.	Coal 2	2	
5.	Bone 0	1½	
6.	Coal 0	6½	
7.	Bone 0	1½	
8.	Coal 4	6 7	8½
9.	Shale, gray.		

"Tidal elevation, 1205', hand level; principal office, Flemington; daily capacity, 500 tons; 110 men employed; electric haulage; used for steam and domestic fuel; shipped east and west; butts, N. 80°, W.; faces, N. 10° E.; coal rises to northwest and southeast; sample collected from Nos. 4 to 8 inclusive, of section in Room No. 33, First Left Heading, by D. B. Reger; I. D. Martin, Chief Clerk, authority for data."

A former analysis of coal from this mine was published in Vol. II (A), W. Va. G. S., page 644.

T. B. Davis Coal Co., T. B. Davis Mine—No. 62 on Map II.

Located ½ mile southeast of Flemington. **Pittsburgh coal.**

		Feet.	Inches.
1.	Black slate		
2.	Shale, gray	1	0
3.	Slate	0	6
4.	Coal, slaty .....0′	3 ″	
5.	Coal 2	7	
6.	Bone 0	1	
7.	Coal 4	6	
8.	Slate, gray 0	0½	
9.	Coal 0	5 7	10½
10.	Shale, gray.		

"Tidal elevation, 1187', hand level; principal office, Piedmont; daily capacity, 250 tons; 55 men employed; rope haulage; used for steam and domestic fuel; shipped east and west; butts; N. 84° W.; faces, N. 6° E.; greatest rise, northeast; sample collected for analysis from Nos. 5, 6 and 7 of section in Main Heading of new mine by D. B. Reger; W. B. Wolf, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II (A), W. Va. G. S., page 644.

McGraw Coal Co., New York Mine—No. 63 on Map II.

Located ¾ mile southwest of Simpson; Pittsburgh coal.

		Feet.	Inches.		Feet.	Inches.
1.	Slate, black					
2.	Coal	2	4			
3.	Bone	0	1			
4.	Coal	4	8		7	1
5.	Shale, gray.					

"Tidal elevation, 1305', hand level; principal office, Frostburg, Md.; daily capacity, 700 tons; 70 men employed; electric haulage; used for steam and domestic fuel; shipped east and west; butts, N. 78° W.; faces N. 12° E.; greatest rise, southeast; sample collected for analysis from Nos. 2, 3 and 4 of section in Fifth Butt Entry by D. B. Reger; C. C. Lovett, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II. (A), W. Va., G. S., page 644.

Grafton Coal & Coke Co., Sand Lick Mine—No. 64 on Map II.

Located 1 mile northwest of Simpson; Pittsburgh coal.

		Feet.	Inches.		Feet.	Inches.
1.	Slate, black					
2.	Coal, bony	0	2			
3.	Coal	1	8			
4.	Bone	0	0½			
5.	Coal	0	6			
6.	Bone	0	1			
7.	Coal	4	2		6	7
8.	Shale, gray					

"Tidal elevation, 1245', hand level; principal office, Grafton; daily capacity, 500 tons; 150 men employed; horse haulage; used for steam and domestic fuel; shipped east and west; butts, N. 82° W.; faces N. 8° E.; greatest rise, southeast; sample collected for analysis from Nos. 3 to 7, inclusive, of section in Room No. 4, Straight Heading, by D. B. Reger; H. A. Fahey, Supt., authority for data."

A former analysis of coal from this mine was published in Vol. II (A), W. Va. G. S., page 644.

The Maryland Coal Company of West Virginia has extensive operations at Wendel on Sand Lick Run in the trough of the Ligonier Syncline. There are several openings, all close together and all using the same tipple.

Maryland Coal Co. of W. Va., Wendel No. 4 Mine—No. 65 on Map II.

Located at Wendel (Simpson P. O.); **Pittsburgh coal.**

				Feet.	Inches.
1.	Sandstone, massive				
2.	Slate, black, checkered at base			4	0
3.	Draw slate, 0″ to			1	8
4.	Coal, slaty	0′	2 ″		
5.	Coal	2	1		
6.	Bone	0	1		
7.	Coal	0	6		
8.	Bone	0	0¾		
9.	Coal	3	11	6	9¾

10. Shale, gray.

"Tidal elevation, 1214.2′, spirit level; principal office, No. 1 Broadway, New York City; daily capacity of Wendel Nos. 1, 4 and 5, 1500 tons; Nos. 1, 2 and 3 are connected and operated together; all five use the same tipple; 240 men employed; electric haulage; used for steam and domestic fuel; shipped east and west; butts, N. 77° 40′ W.; faces, N. 12° 20′ E.; greatest rise, southeast; sample collected for analysis from Nos. 5 to 9, inclusive, of section in Room No. 7, Second Left Heading, by D. B. Reger; E. R. Clayton, Supt., authority for data."

Maryland Coal Co. of W. Va., Wendel No. 1 Mine—No. 66 on Map II.

Located at Wendel; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw slate				
2.	Slate, black			0	0¼
3.	Coal	1′	2 ″		
4.	Bone	0	1¼		
5.	Coal	0	7		
6.	Bone	0	1		
7.	Coal, good	3	8	5	7¼

8. Shale, gray.

"Tidal elevation, 1235.1′, spirit level; principal office, No. 1 Broadway, New York City; for capacity and labor see Wendel No. 4; electric haulage; used for steam and domestic fuel; shipped east and west; butts N. 77° 40′ W.; faces N. 12° 20′ E.; greatest rise, northwest; sample collected for analysis from Nos. 3, 5 and 7 of section in Room No. 10, Pool Heading, by D. B. Reger; E. R. Clayton, Supt., authority for data."

Maryland Coal Co. of W. Va., Wendel No. 5 Mine— No. 67 on Map II.

Located ½ mile north of Wendel; **Pittsburgh coal.**

				Feet.	Inches.
1.	Draw slate				
2.	Coal, good	0′	9 ″		
3.	Bone	0	0½		

				Feet.	Inches.
4. Coal, good	4	9	.....	5	6½

5. Shale, gray.

"Tidal elevation, 1253.7', spirit level; principal office, No. 1 Broadway, New York City; for capacity and labor see Wendel No. 4; west; butts N. 77° 40' W.; faces, N. 12° 20' E.; greatest rise, northwest; sample collected for analysis from Nos. 2, 3 and 4 of section in Room No. 3, First Left Heading, by D. B. Reger; E. R. Clayton, Supt., authority for data."

John L. Robinson, Kunst Mine—No. 68 on Map II.

Located ½ mile southwest of Pruntytown; **Pittsburgh coal.**

				Feet.	Inches.
1. Slate, black, about			.....	4	0
2. Wild coal, slaty	0'	10	"		
3. Slate, gray	0	4			
4. Coal	2	0			
5. Bone	0	1			
6. Coal	4	2	.....	7	5

7. Shale, gray.

"Tidal elevation, 1303' hand level; principal office, Pruntytown; mine owned by Kunst and operated by John L. Robinson; daily capacity, 20 tons; 1 laborer and 3 miners employed; horse haulage; used for steam and domestic fuel; hauled by wagon to Pruntytown and Fetterman; butts, N. 75° W.; faces, N. 15° E.; greatest rise, northeast; sample collected for analysis from Nos. 4, 5 and 6 of section by D. B. Reger; wild coal is left for the roof, but often falls soon after the coal below it is mined; John L. Robinson, operator, authority for data."

This mine does not ship coal by rail, but there is a fine local market at Pruntytown. In this mine the typical roof coal, lying above the draw slate, first described by J. J. Stevenson in Report K, Second Geological Survey of Penna., and later by I. C. White in Vol. II., W. Va. G. S., appears in this section. In this region it is known as the "wild coal."

Through the courtesy of C. McC. Lemley of the B. & O. Railroad, several samples of Pittsburgh coal, taken in Monongalia and Marion counties, were furnished the Survey. The following mines are reported, the analyses being grouped at the end of the sections:

Antler Coal Company.

Located at Round Bottom; **Pittsburgh coal.**

				Feet.	Inches.
0. Sandstone roof			.....		
1. Roof coal, 2'0" to	1'	0	"		
2. Draw slate	1	0			

				Feet.	Inches.
3.	Coal	1	8½		
4.	Bone	0	1		
5.	Coal	1	8		
6.	Bone, 0½" to	0	0¼		
7.	Coal	4	1½		
8.	Sulphur band	0	0⅛		
9.	Coal	0	5	10	0⅜

10. Fire clay.

"Sample collected for analysis from Nos. 3, 5, 6, 7 and 9 of section, about 1300' in mine, by J. C. Heilig and R. C. Tucker."

Harvey Fisher, Farm Mine, Pittsburgh Coal.

Located on Brand run, ½ mile northwest of Round Bottom.

				Feet.	Inches.
0.	Sandstone				
1.	Roof coal	1'	3 "		
2.	Coal	2	3		
3.	Parting	0	0⅛		
4.	Coal	1	5		
5.	Parting	0	0⅛		
6.	Coal	0	6		
7.	Parting	0	0½		
8.	Coal	0	10		
9.	Parting	0	0¼		
10.	Coal	1	11		
11.	Parting, 1" to	0	0½		
12.	Coal	1	10	10	1⅞

13. Fire clay.

"Tidal elevation, 1100', aneroid; butts, N. 78° W.; faces, N. 12° E.; greatest rise, southeast; sample collected for analysis from Nos. 2 to 10 inclusive, and No. 12 of section, 100' in mine, by J. C. Heilig and R. C. Tucker."

Brock Farm Mine.

Located at Flickersville; Pittsburgh coal.

				Feet.	Inches
0.	Sandstone, roof				
1.	Coal	1'	7 "		
2.	Slate	0	0½		
3.	Coal	0	5		
4.	Parting	0	0⅛		
5.	Coal	1	0		
6.	Parting	0	0½		
7.	Coal	2	3		
8.	Sulphur parting	0	0⅛		
9.	Coal	1	6	6	10¼

10. Fire clay.

"Tidal elevation, 990', aneroid; butts, N. 78° W.; faces, N. 12° E.; greatest rise, northeast; sample collected for analysis from Nos. 1, 3, 4, 5, 7 and 9 of section, 150 feet in mine at last working face, by J. C. Heilig and R. C. Tucker."

Alfred Hood, Farm Mine.

Located on Indian Creek, ¾ mile northwest of Opekiska; Pittsburgh coal.

		Feet.	Inches		Feet.	Inches
0.	Sandstone roof					
1.	Roof coal .....2′	0 ″				
2.	Slate 0	0½				
3.	Coal 1	3				
4.	Bone 0	0⅜				
5.	Coal 0	7				
6.	Bone 0	0¼				
7.	Coal 0	9				
8.	Slate 0	0½				
9.	Coal 2	6				
10.	Talc or soapstone parting, 0″ to 0	2				
11.	Coal 0	2				
12.	Sulphur band, 0″ to.....0	2				
13.	Coal 1	0	.....		8	8⅝
14.	Fire clay bottom.					

"Tidal elevation, 960′, aneroid; butts, N. 72° W.; faces, N. 18° E.; greatest rise, northeast; sample collected from Nos. 3, 5, 7, 9, 11 and 13 of section by J. C. Heilig and R. C. Tucker. Mining 6′3″ at present. Sulphur band often contains sulphur balls 3″ to 6″ in diameter and a foot long. Looks like a fragment of a tree with sulphur filling the pores."

Virginia and Pittsburgh Coal & Coke Co., Morgan Mine—No. 25 on Map II.

Located ½ mile east of Montana; Pittsburgh coal.

		Feet.	Inches		Feet.	Inches
0.	Sandstone roof					
1.	Roof coal, not taken out..2′	0 ″				
2.	Coal 0	8½				
3.	Parting, 0″ to 0	0½				
4.	Coal 1	4				
5.	Slate parting 0	0½				
6.	Coal 0	3				
7.	Parting, 0″ to 0	0½				
8.	Coal 0	3				
9.	Slate, 0″ to 0	0½				
10.	Coal 2	0				
11.	Sulphur band, 0⅛″ to.....0	0¼				
12.	Coal 0	6				
13.	Fire clay streak, 0″ to....0	0½				
14.	Coal 0	7				
15.	Parting, contains some sulphur 0	0¼				
16.	Bottom coal 0	7	.....		8	5½
17.	Fire clay.					

"Sample collected from Nos. 4, 6, 8, 10, 12, 14 and 16 of section by J. C. Heilig and R. C. Tucker."

B. & O. Railroad Table of Coal Analyses—Pittsburgh Coal.

Chemical Work by J. B. Krak.

Mine.	Mois.	V. M.	F. C.	Ash.	Sul.	Phos.
Antler Coal Co	0.95	34.75	56.89	7.41	1.72	0.010
Harvey Fisher Farm	1.09	34.85	57.13	6.93	1.74	0.006
Brock Farm.....	0.79	34.27	54.84	10.10	2.36	0.007
Alfred Hood Farm	2.04	32.98	58.26	6.72	1.58	0.008
Va. & Pgh. C. & C. Co. (Morgan)	1.34	34.70	59.68	4.28	1.11	0.017
Average	1.24	34.31	57.36	7.09	1.70	0.010

Messrs. Heilig and Tucker have used great care in noting small slate and sulphur partings in their measured sections and have discarded them from the samples. Since a slate parting less than ¼ inch thick cannot, as a rule, be discarded on the dump, the analyses in the above table show a lower percentage of ash and sulphur than would likely be obtained from samples taken from the car.

Quantity of Pittsburgh Coal Available.

Sufficient information was obtained from the mines and from oil wells to warrant the statement that the Pittsburgh coal is generally present with a thickness of at least 7 feet in the entire region where it is indicated on Map II. With area by Reger the following estimate is made:

Amount of Pittsburgh Coal.

Counties by Districts	Sq. Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Monongalia				
Battelle	56.40	36,096	10,936,392,320	437,455,693
Clay	63.49	40,634	12,389,319,280	495,572,771
Cass	29.66	18,982	5,787,991,440	231,519,658
Grant	34.45	22,048	6,722,876,160	268,915,046
Union	8.22	5,261	1,604,184,120	64,167,365
Morgan	1.21	774	236,008,080	9,440,323
Clinton	0.01	6	1,829,520	73,181
Totals	193.44	123,801	37,678,600,920	1,507,144,037

Counties by Districts	Sq. Miles	Acres	Cubic Feet of Coal	Short Tons of Coal
Marion				
Mannington	100.09	64,058	19,532,565,360	781,302,614
Pawpaw	39.01	24.966	7,682,632,720	307,305,309
Lincoln	56.42	36,109	11,010,356,280	440,414,251
Fairmont	19.81	12,678	3,865,775,760	154,631,030
Grant	13.68	8,755	2,669,574,600	106,782,984
Winfield	3.29	2,106	642,161,520	25,686,461
Union	1.02	653	199,182,760	7,967,310
Totals	233.32	149.325	45,602,249,000	1,824,089,959
Taylor				
Booths Creek	0.43	275	83.853,000	3,354,104
Flemington	6.94	4,442	1,354,454,640	54,178,186
Courthouse	6.73	4,307	1,313,290,440	52,531,618
Totals	14.10	9,024	2.751,598,080	110,063,908
Totals for Area	440.86	282,150	86,032,448,000	3,441,297,904

Approximately 65,000,000 tons of coal have been mined from the three counties. This would leave a balance available of 3,376,000,000 short tons. Of this amount 90 to 95 per cent may be recovered by skilful mining.

MINABLE COALS OF THE CONEMAUGH SERIES.

The coals of the Conemaugh Series, which have been described in detail in Chapter VII., are too thin and irregular to be considered for commercial mining. As outlined in Chapter VII., the Elk Lick, Harlem, Bakerstown and Brush Creek coals all have been mined to a considerable extent for domestic fuel at points where the thicker coals of the Monongahela and Allegheny Series are not available. They will prove to be of considerable value in such localities. Their distribution and thickness are too variable for an intelligent estimate of their tonnage to be made.

MINABLE COALS OF THE ALLEGHENY SERIES.

The Upper Freeport Coal.

The Upper Freeport coal, described in Chapter VIII., stands next in importance after the Pittsburgh coal in the present state of the mining industry. It has been mined extensively in the Deckers creek valley, where its thickness

and uniformly low sulphur content make it unusually valuable. In the work of preparing this report a large number of both commerical and farm mines were examined. The coal was sampled by members of the Survey at all the commercial mines and at several farm mines in Monongalia and Taylor counties. In the portion of Marion county where the coal crops it has not been used to any large extent because the Lower Kittanning coal in the same region is thicker and more easily available. The coal was not sampled in Marion county owing to the lack of favorable opportunity. Nine mines, the sections of which follow in the text, were sampled. The analyses from these mines are published in the Table of Coal Analyses at the end of this chapter under their mine numbers.

Chess Estate, Farm Mine—No. 73 on Map II.

Located 0.6 mile mortheast of Ices Ferry; **Upper Freeport coal.**

		Feet.	Inches.		Feet.	Inches.
1.	Coal, bony, roof, reported.	2′	0 ″			
2.	Coal	2	10			
3.	Slate, gray	0	3			
4.	Coal	0	3	.....	5	4
5.	Slate, gray, pavement.					

[1] Sample collected from No. 2 of section.

It will be noted that the coal in this locality does not show the typical thickness of the bottom coal, as this member, No. 4 of section, is only 3 inches thick.

Elkins Coal & Coke Co. No. 1, Richard Mine—No. 74 on Map II.

Located ¼ mile northeast of Richard; **Upper Freeport coal.**

		Feet.	Inches.		Feet.	Inches.
1.	Sandstone, Mahoning					
2.	Coal, cannel slate	2′	4 ″			
3.	Coal, bony	1	1			
4.	Coal, soft	2	10			
5.	Slate, blue	0	2			
6.	Coal, soft	1	0			
7.	Fire clay shale, soft	0	4			
8.	Coal	0	1			
9.	Fire clay and rock	4	7			
10.	Coal	1	0	.....	13	5

Figure 9.—Showing approximate area of Upper Freeport Coal.

"Elevation, 980', aneroid; greatest rise, S. 57° E.; about 8 per cent; mine capacity, 400 tons; men employed, 450; coal coked on the premises; sample taken for analysis from Nos. 4 and 6 of section by Ray V. Hennen." A sample was also collected from the cannel slate, No. 2.

Connellsville Basin Coke Co.—No. 75 on Map II.

Located at Richard; **Upper Freeport coal.**

		Feet.	Inches
1.	Slate, thickness not exposed		
2.	Cannel slate, some bone at bottom .....3′ 5 ″		
3.	Coal, cannel, better than (2) 1 3		
4.	Coal, bony, 6″ to 0 8		
5.	Coal, soft 2 8		
6.	Slate, blue 0 1		
7.	Coal, soft 2 0	10	0

8. Fire clay, thickness not exposed.

"Tidal elevation, 980', aneroid; greatest rise, S. 76° E.; mine capacity, 300 tons; coal coked on premises; sample collected for analysis from Nos. 5 and 7 by Ray V. Hennen."

Just north of Dellslow station there is a small mine, recently opened, which furnished the coal for steam purposes on the Morgantown and Kingwood Railroad. This mine is known as the **Elkins Coal & Coke Co. No. 3, M. & K. Coaling Station.** Its section is published along with the Dellslow section in Chapter VIII. No sample was taken.

Terence Stewart Farm Mine—No. 76 on Map II.

Located on Booth creek, 1.5 miles northwest of Clinton Furnace; **Upper Freeport coal.**

		Feet.	Inches.
1.	Shale, black		
2.	Shale, gray, with streaks of coal .....2′ 0 ″		
3.	Coal, good 2 1		
4.	Slate 0 2		
5.	Coal, hard, bony 0 9	5	0

6. Shale, gray.

Sample collected for analysis from No. 3 of section by D. B. Reger.

East of Clinton Furnace, on Toms run, the coal is only 3 feet thick as it is approaching the western limit of its

minable area. In the vicinity of Ridgedale and Clinton Furnace, however, it is much thicker, as the two following sections will show:

Baldwin Weaver, Farm Mine—No. 77 on Map II.

Located 1 mile south of Ridgedale; **Upper Freeport coal.**

				Feet.	Inches.
1.	Shale				
2.	Coal, soft	1′	0 ″		
3.	Shale, gray, with streaks of coal	0	9		
4.	Coal, good	2	9		
5.	Shale, gray	0	2		
6.	Coal, good	1	0	5	8
7.	Fire clay.				

"Tidal elevation, 1680′, aneroid; No. 2 of section is not mined but is left for roof, along with No. 3; sample collected for analysis from Nos. 4 and 6, by D. B. Reger."

O. C. Johnson, Farm Mine—No. 78 on Map II.

Located ¼ mile northeast of Clinton Furnace, **Upper Freeport coal.**

				Feet.	Inches.
1.	Shale, dark				
2.	Coal, good	0′	10½″		
3.	Slate	0	0½		
4.	Coal, good	1	0		
5.	Slate, bony	0	3		
6.	Coal, good	2	6		
7.	Shale, gray	0	3		
8.	Coal, good	0	9	5	8
9.	Shale.				

Sample collected for analysis from Nos. 2, 3. 4, 6 and 8 of section by D. B. Reger.

The coal is mined on White Day creek, near the Marion county line, where the following section was measured:

Daniel Morris, Farm Mine—No. 79 on Map II.

Located 0.7 mile northwest of Anita; **Upper Freeport coal.**

				Feet.	Inches.
1.	Shale, gray			1	0
2.	Slate, black			0	1
3.	Coal, medium hard	1′	9 ″		
4.	Slate, black	0	2		
5.	Coal, soft	1	3	3	2
6.	Shale.				

Sample collected for analysis from Nos. 3 and 5 of section by D. B. Reger.

South of Thornton, Taylor county, the coal has been mined and found to have a good thickness. The following is a typical section:

U. G. Jennings, Farm Mine—No. 80 on Map II.

Located 0.7 mile southeast of Thornton; **Upper Freeport coal.**

				Feet.	Inches
1.	Sandstone, massive, Mahoning			30	0
2.	Slate, black			3	0
3.	Coal, bony	1′	0 ″		
4.	Coal, soft, good	2	10		
5.	Slate, gray	0	1½		
6.	Coal, good	1	1		
7.	Band	0	0¼		
8.	Coal	0	1	5	1¾
9.	Fire clay, Bolivar			10	0

Sample collected for analysis from Nos. 4, 6, 7 and 8 of section by D. B. Reger.

In the extreme southeastern corner of Taylor county the coal has been mined and has the following section:

Edith J. Harvey, Farm Mine—No. 81 on Map II.

				Feet.	Inches
1.	Black slate				
2.	Coal, bony	0′	3 ″		
3.	Coal	2	6		
4.	Slate, dark gray	0	2		
5.	Coal	0	11½	3	10½
6.	Fire clay.				

Sample collected for analysis from Nos. 3 and 5 of section by Ray V. Hennen.

Quantity of Upper Freeport Coal Available.

As outlined in Figure 9, the Upper Freeport coal of commercial thickness and regularity is confined to a long strip of territory in the eastern part of the area. West of the Monongahela river the coal does not occur in appreciable quantity, since as a rule it is not recorded in wells. A few wells at Maidsville, Monongalia county, note its presence,

but as others in the same locality did not find it, hence it must be regarded as too irregular to be available. In the neighborhood of Pruntytown, Taylor county, it is recorded in several wells, but the information is too meager to consider its occurrence extensive enough to warrant mining operations. The following table will show the wells that record its occurrence:

List of Wells Recording Upper Freeport Coal.

	NAME OF WELL	LOCATION	Elevation of Well Month A. T.	Depth Feet	Thickness Feet.
	Monongalia County:				
277	James Sanders No. 1.	Maidsville	.....	488	6
320	McClaren core test...	VanVoorhis, 1 m. S.	935B	318.6	1.2
320A	Jos. and David Krepps No. 1	Morgantown, 1.5 m. NW	808L	214	5
321A	Wayne Wilson No. 1..	VanVoorhis, 1 m. S..	925B	335	5
322	VanVoorhis core test No. 3	VanVoorhis	810L	212.3	0.5
322A	Wayne Wilson No. 1..	VanVoorhis, 1 m. SE.	.....	335	5
333	Am. Sheet & T. P. Co. core test No. 3.....	Sabraton	841L	248	4
334	Am. Sheet & T. P. Co. core test No. 5.....	Sabraton, 0.4 m. N..	875L	279	5
	Marion County:				
687	W. R. Jasper Heirs No. 1	Colfax	926L	75	5
688A	Edwin Nuzum No. 2504	Hammond, 0.8 m. NW	.....	152	3
	Taylor County:				
694A	James Riley No. 1....	Hepzibah, 0.2 m. NW	.....	370	8
700	Harrison Jones Heirs No. 1	Pruntytown, 1.1 m. NW	1205B	285	3
700A	Henry Swindler No. 1.	Pruntytown, 1.1 m. NW	.....	450	10
701	Harrison Jones Heirs No. 2	Pruntytown. 0.5 m. NW	1272L	530	5
703	Hugh Evans No. 2....	Pruntytown, 2 m. S 75° W.....	1101L	215	3
704A	T. A. Gawthrop No. 1.	Pruntytown, 2 m. S W	.....	324	4
711	John B. Cather No. 1.	Flemington, 1.9 m. NW	1140B	420	4
725	E. E. McDaniel core test	Stonehouse, 0.7 m. NE	1105B	28	1.2

A careful study of all the information obtained in the field shows that the Upper Freeport coal, in the region outlined in Figure 9, varies greatly in thickness, but probably 3 feet would represent its average thickness better than any other figure. This thickness has been used by Reger in the following estimate of the quantity available. The area was measured by planimeter. The amount of coal already mined is too small to make any deduction necessary on that account.

Available Upper Freeport Coal.

Counties by Districts.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Monongalia				
Grant	1.17	748.8	97,853,184	3,914,127
Union	14.75	9,440.0	1,233,619,200	49,344,768
Morgan	12.25	7,840.0	1,024,531,200	40,981,248
Clinton	25.25	16,160.0	2,111,788,800	84,471,552
Totals	53.42	34,188.8	4,467,792,384	178,711,695
Marion				
Winfield	17.02	10,892.8	1,423,471,104	56,938,844
Union	0.99	633.6	82,798,848	3,311,954
Totals	18.01	11,526.4	1,506,269,952	60,250,798
Taylor				
Fetterman	30.14	19,289.6	2,520,764,928	100,830,597
Knottsville	5.29	3,385.6	442,430,208	17,697,208
Totals	35.43	22,675.2	2,963,195,136	118,527,805
Totals for Area	106.86	68,390.4	8,937,257,472	357,490,298

The Upper Kittanning Coal.

The Upper Kittanning coal, described in detail in Chapter VIII., has received but little attention as a mining proposition, but its wide distribution and good quality make it a valuable resource. It has been mined commercially in Taylor county along the Tygart Valley river. The mine is not in operation, but it was examined and sampled. The mine section is given below and the analysis is published in the Table of Coal Analyses at the end of this chapter under the mine number.

Winona Coal & Coke Co. No. 1 Mine—No. 84 on Map II.

Located at Coffman (Grafton R. F. D.); **Upper Kittanning coal.**

		Feet.	Inches
1.	Sandstone, massive.....		
2.	Slate, black.....	0	2
3.	Coal, good.....2′ 10″		
4.	Shale, gray.....0 1		
5.	Coal, good.....0 9	3	8
6.	Fire clay, gray, visible.....	2	6

"Tidal elevation, 1073′, hand level; principal office, Ruffs Dale, Pa.; not in operation (Nov. 23, 1911); butts, N 78° W; faces, N 12° E; greatest rise, northwest; sample collected from Nos. 3 and 5 of section in Main Heading by D. B. Reger; F. D. Tarr, Supt., authority for data."

Quantity of Upper Kittanning Coal Available.

A large number of openings, examined at outcrop, show the Upper Kittanning coal to be 3 feet or less in thickness. The well records which note its presence make it much greater, as shown by the following table:

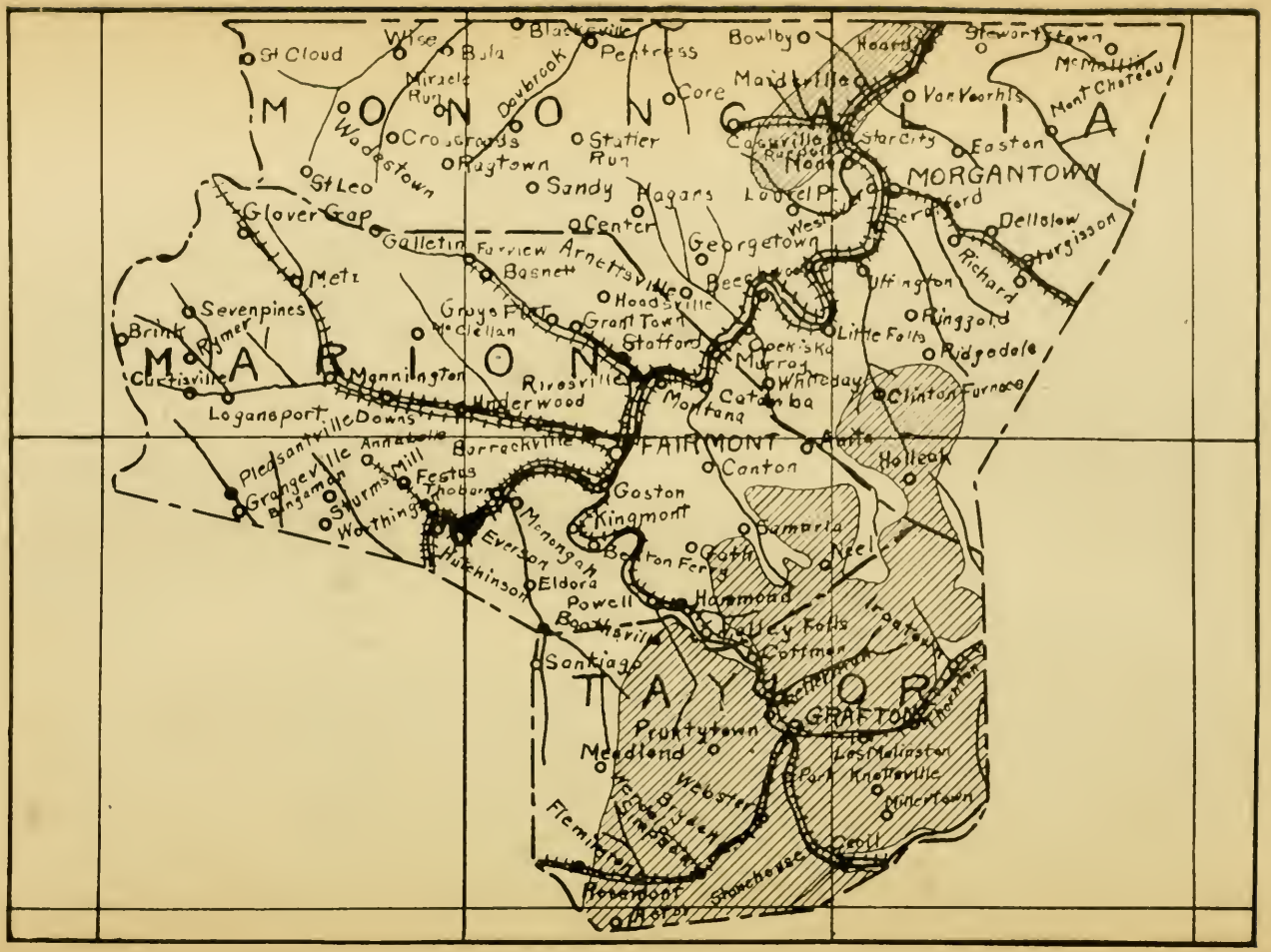

Figure 10.—Showing approximate area of Upper Kittanning Coal.

List of Wells Recording Upper Kittanning Coal.

No on Map	NAME OF WELL	LOCATION	Elevation of Well Mouth	Depth. Feet.	Thickness Feet.
	Monongalia County:				
272	John Laird No. 1.....	Maidsville, 1.4 m. SW	1135B	971	5
273	Elza Davis No. 1.....	Maidsville, 1.1 m. W.	1050B	880	5
274	Wm. H. Smith No. 1..	Cassville, 1.1 m. W..	1155B	998	5
275	E. H. Clevenger No. 1	Maidsville, 1.2 m. N W	1170B	1045	5
277	James Sanders No. 1.	Maidsville	.....	601	6
279	Jasper Stone No. 1...	Maidsville, 1 m. NW.	895B	705	.....
280	M. G. Murphy No. 2...	Maidsville, 1.2 m. N W	910B	727	4
281	Peter Lazzell No. 1...	Maidsville. 1.3 m. N W	1170B	933	6
283	T. A. and J. F. Keenan No. 1	Maidsville, 1.2 m. N 50° W.....	1035B	837	3
290	Sanford Barrickman No. 1	Cassville, 1.8 m. SE	1085B	986	5
321A	Wayne Wilson No. 1..	VanVoorhis, 1 m. S..	925B	416	4
322	VanVoorhis core test No. 3	VanVoorhis	810L	300.3	3.8
326	Francis Costolo No. 1.	Cheat Haven, 1.4 m. S	808L	375	3
332	Snyder No. 1.....	Morgantown	808L	220	4
333	Am. Sheet & T. P. Co. core test No. 3.....	Sabraton	841L	364.5	1.8
334	Am. Sheet & T. P. Co. core test No. 5.....	Sabraton, 0.4 m. N..	875L	402.7	2.8
	Taylor County:				
694A	James Riley No. 1....	Hepzibah, 0.2 m. NW	.....	470	8
697	Martha Tucker No. 1..	Valley Falls, 1 m. S 10° W.....	1080B	16	4
700	Harrison Jones Heirs No. 1	Pruntytown, 1.1 m. NW	1205B	385	7
700A	Henry Swindler No. 1.	Pruntytown, 1.1 m. NW	.....	588	6
701	Harrison Jones Heirs No. 2	Pruntytown, 0.5 m. NW	1272L	640	5
703	Hugh Evans No. 2....	Pruntytown, 2 m. S 75° W.....	1101L	340	5
711	John B. Cather No. 1.	Flemington, 1.9 m. NW	1140B	527	8
715	Sarah E. Whitescarver No. 1	Pruntytown, 2.4 m. SW	1115B	500	6
715A	Clare F. Shafer No. 1.	Pruntytown, 2.4 m. SW	1240B	735	3
718	M. Rector No. 1.....	Grafton, 2 m. SW...	985L	196	8
719	A. J. Bartlett core test	Webster	1006L	217	4.8
724	E. H. Bennett core test No. 2.....	Stonehouse, 0.2 m. N	1022L	90	2

It must not be taken for granted that the large body of coal shown by Figure 10 in Taylor county is of commercial thickness at all points, because the records are too scattered to make the evidence conclusive, but since it is found in such borings as have been made, this district is outlined as probably containing the coal. Based on measurements at outcrop and thicknesses given in wells, an assumed thickness of 3 feet is warranted. With this assumption an estimate by Reger gives the following tabulated results:

Available Upper Kittanning Coal.

Counties.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Monongalia	35.28	22,579	2,950,623,720	118,024,950
Marion	17.15	10,976	1,434,343,680	57,373,746
Taylor	137.44	87,962	11,494,874,160	459,794,966
Totals	189.87	121,517	15 879,841,560	635,193,662

The Lower Kittanning Coal

The Lower Kittanning coal, described in detail in Chapter VIII, is of wide distribution and excellent quality. As shown by the Table of Coal Analyses it is almost equal to the Upper Freeport in calorific value and the sulphur content so low that much of it can be used for coke. Its outcrop is shown on Map II and its areal distribution on Figure 11. There are only three commercial mines, all located in Taylor county. These have been visited and sampled by members of the Survey. Their description follows in the text and the analyses may be found in the table at the end of this chapter under their mine numbers.

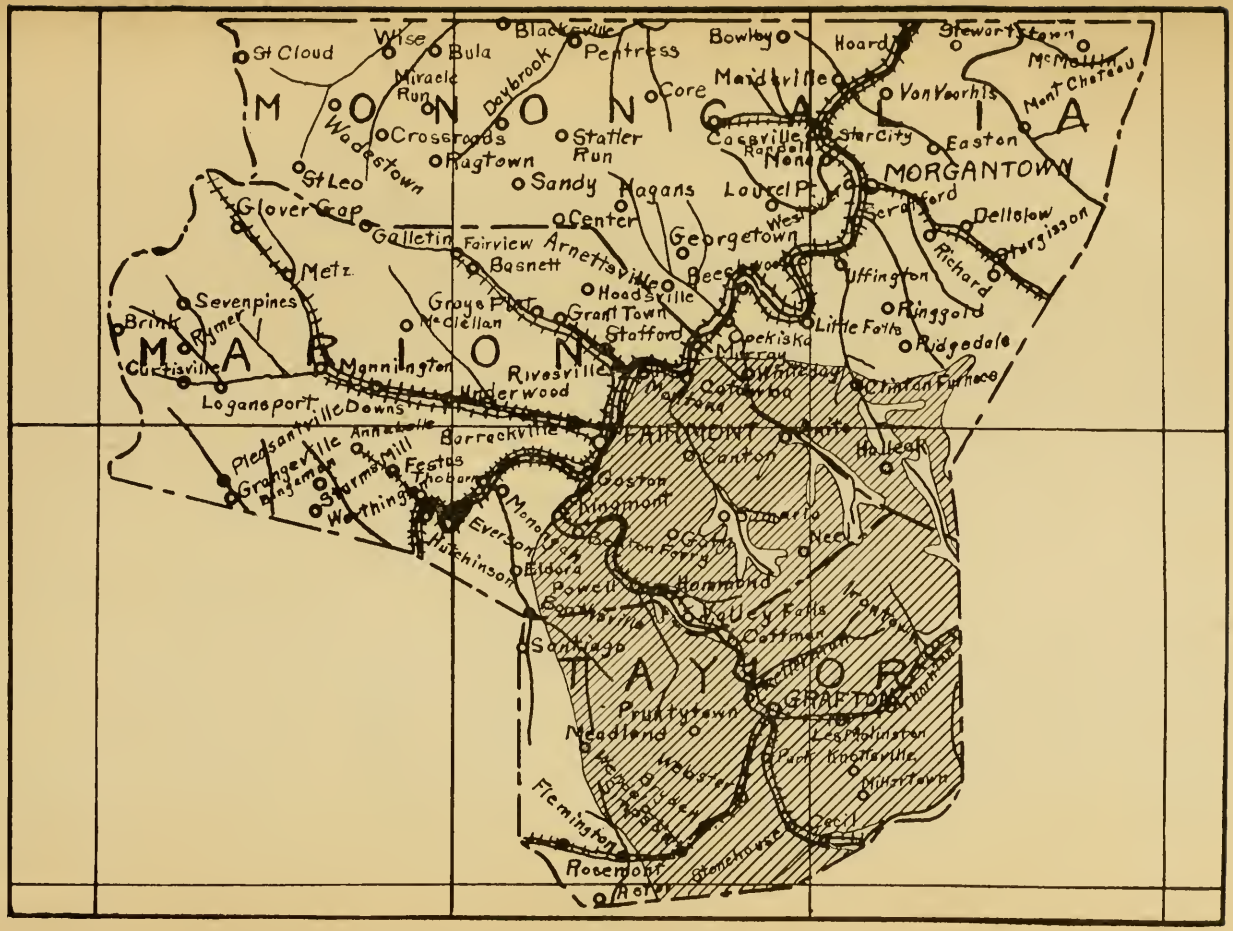

Figure 11.—Showing approximate area of Lower Kittanning Coal.

Winona Coal & Coke Co., Mine No. 2.—No. 95 on Map II.

Located at Coffman (Grafton R. F. D.): **Lower Kittanning coal.**

			Feet.	Inches
1.	Sandstone, massive			
2.	Shale, hard, gray		2	0
3.	Slate, black		0	3
4.	Cannel slate		0	5
5.	Coal, good, hard	1′ 2″		
6.	Coal, bony	0 9		
7.	Coal, good, soft	2 10	4	9
8.	Shale, gray.			

"Tidal elevation, 1014′; hand level; principal office, Ruffs Dale, Pa.; daily capacity, 300 tons; 20 laborers and 20 miners employed; electric haulage; used for steam and coke; shipped east and west; butts, N 78° W; faces N 12° E; greatest rise, northwest; sample collected for analysis from Nos. 5 and 7 of section in Room No. 6, Third Left Heading, by D. B. Reger; F. C. Tarr, Supt., authority for data."

This company operates 30 bee-hive coke ovens, the product from which is mostly used for heating purposes. When a superior grade of coke is desired, the bottom coal, No. 7 of section, is used alone. A sample of 72-hour coke shows the following analysis according to Messrs. Hite and Krak:

	Per cent.
Moisture	0.04
Volatile Matter	0.83
Fixed Carbon	82.97
Ash	16.16
Total	100.00
Sulphur	2.54
Phosphorus	0.53

Sterling Coal Co.—No. 97 on Map II.

Located at Cecil; **Lower Kittanning coal.**

			Feet.	Inches
1.	Slate, good roof			
2.	Coal medium hard	1′ 6″		
3.	Coal, bony, 6″ to	0 8		
4.	Coal, soft	1 8	3	10
5.	Slate.			

"Tidal elevation, 1100′, aneroid; greatest rise, southeast; mine capacity, 300 tons; used for coke, steam and domestic purposes; authority for mine data, J. E. Hamilton, mine foreman; sample collected for analysis from Nos. 2 and 4 of section by Ray V. Hennen."

Overholt Coal & Co.—No. 98 on Map II.

Located 0.4 mile southwest of Cecil; **Lower Kittanning coal.**

		Feet.	Inches
1.	Sandstone, hard	6	0
2.	Sandstone, shaly	4	0
3.	Slate, dark	5	0
4.	Coal ..... 0′ 1″		
5.	Slate, black, cannel 0 5		
6.	Coal, good, hard 1 8		
7.	Coal, hard, with slate and bone 0 10		
8.	Coal 0 6		
9.	Slate, black 0 0½		
10.	Coal, soft, good 2 0	5	6½
11.	Shale, gray.		

"Tidal elevation 1051′, spirit level; greatest rise, southeast; sample collected for analysis from Nos. 6, 8, 9 and 10 of section in Main Heading by D. B. Reger."

This mine is located on the south side of the Tygart Valley river along the Buckhannon and Northern railroad right-of-way. When construction work was abandoned on the railroad, work ceased also at the mine. The sample taken shows a large amount of moisture which is due to the fact that a fresh working face could not be found. The air dried sample indicates more clearly the true quality of the coal.

Quantity of Lower Kittanning Coal Available.

As shown on Figure 11, there is a large amount of Lower Kittanning coal lying under drainage in Marion and Taylor counties. Although the evidence is by no means absolute, the coal has been indicated on the figure for this locality because nearly all the well records note its presence. Many additional core tests would be necessary to determine fully its extent and character. The following table gives the evidence upon which this assumption was based:

List of Wells Recording Lower Kittanning Coal.

No. on Map	NAME OF WELL	LOCATION	Elevation of Well Mouth A. T.	Depth. Feet	Thickness. Feet
	Monongalia County:				
272	John Laird (E. Roach) No. 1	Maidsville, 1.4 m. S 80° W	1135B	1021	6
322A	Wayne Wilson No. 1	VanVoorhis, 1 m. SE		494	3
344	Rose Watson No. 1907	Smithtown, 0.4 m. S.	970B	227	5
	Marion County:				
666	A. Boutlou No. 1	Montana, 1 m. W	950B	1020	5
680	Harriet Frum No. 1	Boothsville, 0.6 m. N 20° W	995B	640	8
687	W. R. Jasper Hrs. No. 1	Colfax	926L	252	10
688	J. F. Vangilder No. 1	Kingmont, 1.6 m. E.	975B	583	7
	Taylor County:				
700	Harrison Jones Hrs. No. 1	Pruntytown, 1.1 m. NW	1205B	455	5
700A	Henry Swindler No. 1.	Pruntytown, 1.1 m. NW		682	12
702	C. E. Dunham No. 1	Pruntytown, 1:5 m. W	1268L	605	2
702A	Brown Hrs. No. 1	Pruntytown, 1.6 m. W		468	8
704A	T. A. Gawthrop No. 1.	Pruntytown 2 m. SW		470	4
705	Geo. W. Reynolds No. 1	Meadland, 2 m. E	1180B	528	10
708	Lizzie E. Morrow No. 2250	Meadland, 0.7 m. E.	1328L	480	3
709	Dan Copeland No. 1	Meadland, 1.1 m. SE	1372B	670	10
715A	Clare F. Shafer No. 1.	Pruntytown, 2.4 m. SW	1240B	795	3
719	A. J. Bartlett core test	Webster	1006L	266	5.8
724	E. H. Bennett core test No. 2	Stonehouse, 0.2 m. N	1022L	133.5	6
726	Lucinda McDaniel No. 1	Stonehouse	998L	90	4

From the table above and from measurements made at outcrop, it is safe to assume an average thickness of 4 feet for the Lower Kittanning coal in the territory outlined in Figure II. With this assumption the following tonnage estimate has been prepared by Reger:

Available Lower Kittanning Coal.

Counties.	Square Miles.	Acres.	Cubic Feet of Coal.	Short Tons of Coal.
Monongalia	24.01	15,366	2,677,371,840	107,094,874
Marion	66.40	42,496	7.408,503,040	296,340,122
Taylor	143.32	91,725	15,982,164,000	639,286.560
Total	233.73	149.587	26,068,038,880	1,042,721,556

MINABLE COALS OF THE POTTSVILLE SERIES.

The Upper Mercer Coal

The Upper Mercer Coal, which has been described in Chapter IX, is the only coal of the Pottsville Series that is thick enough to be mined. As shown by the Table of Coal Analyses at the end of this chapter, this coal is high in ash, but low in sulphur and phosphorus. Since it nearly always contains a thick stratum of soft shale near the middle that easily crumbles, there is difficulty in mining the coal successfully.

Quantity of Upper Mercer Coal Available.

This coal is not recorded in wells west of the Monongahela river. East of the river it is of minable thickness just southeast of Sturgisson, Monongalia county. North of Halleck it was noted at several points. At Powell and Valley Falls on the Tygart Valley river it is well developed. In Booths Creek and Courthouse districts, Taylor county, several wells record its occurrence but the evidence is too uncertain to make an intelligent estimate of the amount. The following table shows such information as could be had concerning its occurrence under drainage:

List of Wells Recording Upper Mercer Coal.

No. on Map	NAME OF WELL	LOCATION	Elevation of Well Mouth A. T.	Depth. Feet	Thickness. Feet
	Monongalia:				
326	Francis Costolo No. 1.	1.2 m. SE of Cheat Haven	808L	560	3
	Taylor County:				
697	Martha Tucker No. 1.	Valley Falls, 1 m. S 10° W.	1080B	235	7
700	Harrison Jones Hrs. No. 1	Pruntytown, 1.1 m. NW	1205B	530	9
700A	Henry Swindler No. 1.	Pruntytown, 1.1 m. NW		825	9
702	C. E. Dunham No. 1.	Pruntytown, 1.5 m. NW	1268L	785	2
702A	Brown Heirs No. 1.	Pruntytown, 1.6 m. W		585	3
703	Hugh Evans No. 2.	Pruntytown, 2 m. S. 75° W.	1101L	475	6
704A	T. A. Gawthrop No. 1.	Pruntytown, 2 m. SW		580	6
705	Geo. W. Reynolds No. 1	Meadland, 2 m. E.	1180B	653	10
715	Sarah E. Whitescarver No. 1	Pruntytown 2.4 m. SW	1115B	690	8
715	Clare F. Shafer No. 1.	Pruntytown, 2.4 m. SW	1240B	885	4

Summary of Available Coal.

	Short Tons.
Washington coal	585,188,597
Waynesburg coal	1,301,640,473
Sewickley coal	1,979,590,715
Redstone coal	5,027,032
Pittsburgh coal	3 376,000,000
Upper Freeport coal	357,490,298
Upper Kittanning coal	635,193,662
Lower Kittanning coal	1,042,721,556
Grand total	9,282,852,243

This summary represents the amount of coal remaining in the ground. Since the entire amount cannot be mined, a reduction must be made for pillars. Many of the companies operating the Pittsburgh coal recover 95 per cent, but the recovery of all the other seams will be less, some of them not

exceeding 50 per cent. Perhaps an estimated recovery of 80 per cent would be within safe limits. On this basis the total amount of coal available would be 1,426,281,794 short tons.

MINABLE COAL BY MAGISTERIAL DISTRICTS.

Monongalia County.

Battelle District.—The Washington, Waynesburg, Sewickley and Pittsburgh coals are present over the entire area of Battelle district. They are all deeply buried underground and available only for shaft mining. The elevation of the Pittsburgh coal above sea level is shown on Map II and the approximate elevation of the others may be computed at any location desired. In addition to the discussion in this chapter these coals have been described in Chapters V and VI. The only surface coals in the district are so thin that they cannot be mined successfully.

Clay District.—In Clay district are found the Washington, Waynesburg, Sewickley and Pittsburgh coals. Of these, the Washington crops in the eastern end of the district and the Waynesburg crops at one locality, near Hagans in the extreme southeastern corner. The crop of both these coals is shown on Map II. The coals are all described in Chapters V and VI and the tonnage estimates given in the present chapter.

Cass District.—In Cass district the minable coals are the Washington, Waynesburg, Sewickley, Redstone, Pittsburgh, and Upper Kittanning. Of these, all except the Upper Kittanning crop at some locality in the district. The crops of the Washington, Waynesburg and Pittsburgh are shown on Map II. The descriptions of these coals are given in Chapters V, VI and VIII, and the tonnage estimates in the present chapter.

Grant District.—The minable coals of Grant district are the Washington, Waynesburg, Sewickley, Redstone, Pittsburgh and Upper Freeport, all of which reach the surface. The crops of the Washington, Waynesburg, Pittsburgh and Upper Freeport are shown on Map II. These coals are described in Chapters V, VI and VIII and the tonnage estimates given in the present chapter. The quantity of Upper Freeport is very small.

Union District.—The minable coals of Union district are the Sewickley, Pittsburgh and Upper Freeport, all of which reach the surface. The crops of the Pittsburgh and Upper Freeport are shown on Map II. The descriptions of these coals are given in Chapters VI and VIII and the tonnage estimates in the present chapter. Map II also shows the western boundary where the Upper Freeport becomes too thin for mining.

Morgan District.—The minable coals of Morgan district are the Pittsburgh, Upper Freeport and Upper Mercer, all of which crop above drainage at some locality. The crops of the Pittsburgh and Upper Freeport are shown on Map II. The descriptions of these coals are given in Chapters VI, VIII and IX and the tonnage estimates in the present chapter.

Clinton District.—The minable coals of Clinton district are the Pittsburgh, Upper Freeport, Upper Kittanning, Lower Kittanning and Upper Mercer, all of which crop above drainage. Of these, the crops of the Pittsburgh, Upper Freeport and Lower Kittanning are shown on Map II. The descriptions of these coals are given in Chapters VI, VIII and IX and the tonnage estimates in the present chapter.

Marion County.

Mannington District.—The minable coals of Mannington district are the Washington, Waynesburg, Sewickley and Pittsburgh. Of these, the Washington crops over a limited area in the eastern portion of the district and the Waynesburg in a few localities in the southeast corner. The crops of both are shown on Map II. Map II also shows the elevation of the Pittsburgh above sea level. The descriptions of these coals are given in Chapters V and VI and the tonnage estimates in the present chapter.

Pawpaw District.—The minable coals of Pawpaw district are the Washington, Waynesburg, Sewickley and Pittsburgh, all of which crop at some locality. The crops of the Washington, Waynesburg and Pittsburgh are shown on Map II. The descriptions of these coals are given in Chapters V and VI and the tonnage estimates in the present chapter.

Lincoln District.—The minable coals of Lincoln district are the Washington, Waynesburg, Sewickley and Pittsburgh all of which crop at some locality. The crops of the Washington, Waynesburg and Pittsburgh are shown on Map II. The descriptions of these coals are given in Chapters V and VI and the tonnage estimates in the present chapter.

Fairmont District.—In Fairmont district the minable coals are the Washington, Waynesburg, Sewickley and Pittsburgh, all of which crop at some locality. The crops of the Washington, Waynesburg, and Pittsburgh are shown on Map II. The descriptions of these coals are given in Chapters V and VI and the tonnage estimates in the present chapter.

Grant District.—The minable coals of Grant district are the Waynesburg, Pittsburgh, Lower Kittanning and Upper Mercer, all of which crop at some locality. The Waynesburg is only found in a few isolated hill-tops and is scarcely worthy of mention. The crops of the Waynesburg, Pittsburgh and Lower Kittanning are shown on Map II. The descriptions of these coals are given in Chapters VI, VIII and IX and the tonnage estimates in the present chapter.

Winfield District.—In Winfield district the minable coals are the Pittsburgh, Upper Freeport, Upper Kittanning and Lower Kittanning, all of which crop at some locality. The crops of all except the Upper Kittanning are shown on Map II. These coals are described in Chapters VI and VIII and the tonnage estimates given in the present chapter.

Union District.—The minable coals of Union district are the Pittsburgh, Upper Freeport, Upper Kittanning, Lower Kittanning and Upper Mercer, all of which crop in some locality. The crops of the Pittsburgh, Upper Freeport, and Lower Kittanning are shown on Map II. These coals are described in Chapters VI, VIII and IX and the tonnage estimates given in the present chapter.

Taylor County.

Booths Creek District.—In Booths Creek district the minable coals are the Pittsburgh, Upper Kittanning, Lower Kittanning and Upper Mercer, all of which crop at some

locality. The Upper Freeport coal is not of minable thickness where its horizon crops and it is seldom noted in well records where it should lie under drainage. The crops of the Pittsburgh coal, the Upper Freeport horizon, and the Lower Kittanning coal are shown on Map II. These coals are described in Chapters VI, VIII and IX and the tonnage estimates given in the present chapter.

Flemington District.—The minable coals of Flemington district are the Pittsburgh, Upper Kittanning and Lower Kittanning. Of these, only the Pittsburgh crops above drainage. Its crop is shown on Map II. These coals are described in Chapters VI and VIII, and the tonnage estimates given in the present chapter. The evidence regarding the Upper Freeport is not conclusive, but most of the wells drilled do not record it.

Courthouse District.—In Courthouse district the minable coals are the Pittsbrugh, Upper Kittanning, Lower Kittanning and possibly the Upper Mercer. The well records indicate that the Upper Freeport is too irregular to be of value. The Pittsburgh, which crops above drainage, is shown on Map II. These coals are described in Chapters VI, VIII and IX, and the tonnage estimates are given in the present chapter.

Fetterman District.—The minable coals of Fetterman district are probably the Upper Freeport, Upper Kittanning and Lower Kittanning. These coals all crop at some locality. The fact that they are of minable thickness where they crop in the district and in adjoining regions is the only evidence for believing that they are good where their horizons are under drainage. There are no wells or core tests. Since the Upper Mercer coal does not crop there is no information on which to base a statement regarding it. The crops of the Upper Freeport and Lower Kittanning are shown on Map II. These coals are described in Chapter VIII and their tonnage estimates given in the present chapter.

Knottsville District.—In Knottsville district the minable coals are the Upper Freeport, Upper Kittanning and Lower Kittanning. There are limited areas of Bakerstown coal that is of good quality and thickness. The Upper Freeport, in the western part of the district, is not of minable thickness either

at its crop or in the bore-holes that penetrate it. There is no evidence regarding the Upper Mercer except the McDaniel well (126) at Stonehouse where it was not found. The crops of the Upper Freeport and Lower Kittanning are shown on Map II. These coals are described in Chapters VII and VIII and tonnage estimates given in the present chapter.

TABLE OF COAL ANALYSES.

The following table, containing the chemical analysis, calorific determination and fuel ratio of 101 mines and prospects sampled in the territory of this report, is the exclusive work of members of the Survey staff. The chemical work is mostly by J. B. Krak, Assistant Chemist, under the supervision and with the assistance of B. H. Hite, Chief Chemist. The numbers at the left hand margin correspond to the numbers given with the mine sections in the text and on Map II. For additional explanation see page 614.

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." = air dried, and "A. R." = as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
1	Lewis Lemley	Monongalia.	Nineveh, Min. sect.	A. R.	1.62	35.32	43.67	0.128	19.39	3.42	60.65	4.67	10.85	1.02	11650	11010	2.01
2	Levi White	Monongalia.	Dunkard, Min. sect.	A. R.	1.91	35.88	47.51	0.215	14.70	1.83	66.65	4.60	11.08	1.14	12190	11770	2.59
3	Crop, public road	Monongalia.	Jollytown, Min. sect.	A. R.	1.93	33.63	47.79	0.053	16.65	2.37	65.20	4.73	9.91	1.14	12000	11740	2.45
4	Geo. C. Wright	Monongalia.	Washington, U. bench	A. R.	1.24	33.68	43.05	0.012	22.03	3.51	60.16	4.27	9.04	0.99	11420	10840	1.94
4	Geo. C. Wright	Monongalia.	Washington, L. bench	A. R.	1.55	33.74	57.05	0.023	7.66	2.02	74.50	5.17	9.35	1.30	13700	13400	4.38
5	Unknown	Marion.	Washington, L. bench	A. R.	1.43	35.99	50.86	0.005	11.72	2.98	69.55	5.12	9.58	1.05	12710	12670	3.27
	Average		Washington, L. bench	A. R.	1.49	34.86	53.96	0.014	9.69	2.50	72.02	5.15	9.46	1.18	13205	13035	3.76
6	Crop, public road	Marion.	W'nesb'g 'A' Min. sect.	A. R.	1.81	34.59	45.99	0.035	18.51	4.32	60.89	4.43	10.83	1.02	11530	10940	2.08
7	Clark Wade	Monongalia.	Waynesb'g Min. sect.	A. R.	1.57	32.73	56.71	0.008	8.99	0.93	72.18	4.68	11.88	1.34	13460	12520	3.46
7	Clark Wade	Monongalia	Waynesb'g, L. bench.	A. R.	1.26	34.72	54.02	0.016	10.00	0.99	74.44	4.85	8.29	1.43	13420	13240	4.07
7A	Chas. Braud	Monongalia.	Waynesb'g Min. sect.	A. R.	0.40	36.50	52.91	0.015	10.19	2.25	71.38	4.77	10.05	1.36	13240	12650	3.53
8	Wm. Glasscock	Monongalia.	Waynesb'g L. bench.	A. R.	1.46	35.15	47.27	0.012	16.12	4.07	64.58	4.80	9.20	1.23	12340	11820	2.55
9	John Statler	Marion.	Waynesb'g Min. sect.	A. R.	1.82	34.73	51.71	0.009	11.74	1.98	69.97	5.23	9.69	1.39	12960	12750	3.27
10	C. J. Martin	Marion.	Waynesb'g Min. sect.	A. R.	1.63	33.14	48.05	0.015	17.18	1.76	66.51	4.49	8.74	1.32	12520	11850	2.57
11	M. V. Traction Co.	Marion.	Waynesb'g Min. sect.	A. R.	1.69	34.86	52.58	0.050	10.87	2.96	69.02	4.83	10.86	1.46	12950	12310	3.18
12	W. I. Nutter	Marion.	Waynesb'g Min. sect.	A. R.	1.89	34.15	49.70	0.023	14.26	3.51	67.42	4.51	9.05	1.25	12440	12040	2.89
	Average	Monongalia.	Waynesb'g Min. sect.	A. R.	1.50	34.35	51.95	0.020	12.20	2.23	69.41	4.75	10.05	1.35	12928	12353	3.12
	Average		Waynesb'g, L. bench.	A. R.	1.36	34.94	50.64	0.014	13.06	2.53	69.51	4.83	8.64	1.33	12880	12530	3.31
13	B. & O. R. R. cut	Marion.	L. Uniont'n, Min. sect	A. R.	7.29	33.96	50.12	0.010	8.63	1.79	63.31	4.54	20.50	1.23	11180	10510	2.17
Well No. 20	T. W. Kinnan	Monongalia.	Sewickley, Min. sect.	A. R.	0.78	39.66	49.41	0.012	10.15	2.75	70.00	4.89	11.06	1.15	13500	13070	3.30
14	S. Z. T. Martin	Monongalia.	Sewickley, Min. sect.	A. R.	1.54	35.33	55.95	0.066	7.18	1.54	74.84	4.97	10.18	1.29	13870	13240	4.31
15	Parker Run C. & C. Co.	Marion.	Sewickley, Min. sect.	A. D.	0.34	38.69	52.30	0.006	8.67	3.97	73.88	5.09	7.12	1.27	13640	13510	4.68
15	Parker Run C. & C. Co.	Marion.	Sewickley, Min. sect.	A. R.	0.60	38.59	52.16	0.006	8.65	3.96	73.69	5.11	7.33	1.26	13600	13480	4.61
15A	Dakota C. & C. Co.	Marion.	Sewickley, Min. sect.	A. D.	0.72	38.13	52.07	0.035	9.08	3.61	74.43	4.97	6.65	1.26	13602	13539	4.73
15A	Dakota C. & C. Co.	Marion.	Sewickley, Min. sect.	A. R.	1.16	37.96	51.84	0.035	9.04	3.59	74.11	4.98	7.03	1.25	13542	13479	4.61
	Average	Marion.	Sewickley, Min. sect.	A. D.	0.53	38.41	52.19	0.020	8.87	3.79	74.16	5.03	6.88	1.27	13621	13525	4.71
	Average		Sewickley, Min. sect.	A. R.	1.02	37.89	52.34	0.030	8.75	2.96	73.16	4.99	8.90	1.24	13628	13317	4.21

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D."—air dried, and "A. R."—as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
15B	A. H. Tait	Monongalia.	Redstone, Min. sect.	A. R.	1.44	32.08	55.61	0.014	10.87	1.77	70.61	4.58	10.96	1.21	12630	12330	3.23
Well No. 20	T. W. Kinnan	Monongalia.	Pittsburgh, Min. sect.	A. R.	0.95	40.65	52.57	0.007	5.83	2.53	76.90	5.29	8.23	1.22	14200	13930	5.47
16	Wm. Robinson	Monongalia.	Pittsburgh, Min. sect.	A. R.	1.21	32.71	61.23	0.014	4.85	3.51	79.24	4.91	6.04	1.45	14360	14240	7.28
17	Elkins C. & C. Co. No. 5	Monongalia.	Pittsburgh, Min. sect.	A. D.	1.40	34.80	54.57	0.019	9.23	2.07	78.55	4.64	4.31	1.20	14382	14056	5.80
17	Elkins C. & C. Co. No. 5	Monongalia.	Pittsburgh, Min. sect.	A. R.	2.09	34.56	54.18	0.019	9.17	2.06	78.00	4.72	4.86	1.19	14282	13975	5.56
18	Great Scott C. & C. Co.	Monongalia.	Pittsburgh, Min. sect.	A. D.	0.48	37.03	53.67	0.006	8.82	3.66	75.28	5.13	5.80	1.31	13760	13830	5 15
18	Great Scott C. & C. Co.	Monongalia.	Pittsburgh, Min. sect.	A. R.	0.75	36.93	53.52	0.006	8.80	3.65	75.07	5.15	6.02	1.31	13720	13790	5.07
18	Great Scott C. & C. Co.	Monongalia.	Pittsburgh, head coal.	A. D.	0.42	38.28	51.30	0.055	10.00	5.36	71.96	5.23	6.14	1.31	13630	13450	4.45
18	Great Scott C. & C. Co.	Monongalia.	Pittsburgh, head coal.	A. R.	6.56	38.23	51.22	0.055	9.99	5.35	71.86	5.24	6.25	1.31	13610	13430	4.42
19	Antler Coal Co.	Monongalia.	Pittsburgh, Min. sect.	A. D.	0.79	35.95	56.69	0.005	6.57	2.28	76.10	4.89	8.86	1.30	14030	13510	4.93
19	Antler Coal Co.	Monongalia.	Pittsburgh, Min. sect.	A. R.	1.25	35.78	56.43	0.005	6.54	2.27	75.74	4.92	9.24	1.29	13970	13450	4.80
20	Cons. No. 30 (Beechwood)	Monongalia.	Pittsburgh, Min. sect.	A. D.	0.78	36.02	56.60	0.007	6.60	1.84	76.37	5.20	8.60	1.39	14160	13740	5.02
20	Cons. No. 30 (Beechwood)	Monongalia.	Pittsburgh, Min. sect.	A. R.	4.46	34.68	54.50	0.007	6.36	1.77	73.54	5.42	11.58	1.33	13640	13230	4.10
21	Pittsburgh Steam Coal Co.	Monongalia.	Pittsburgh, Min. sect.	A. D.	0.67	38.32	55.36	0.005	5.65	1.95	77.28	5.19	8.56	1.37	14290	13870	5.44
21	Pittsburgh Steam Coal Co.	Monongalia.	Pittsburgh, Min. sect.	A. R.	0.91	38.23	55.22	0.005	5.64	1.94	77.10	5.21	8.74	1.37	14260	13840	5.36
22	Cons. No. 45 (Murray)	Marion.	Pittsburgh, Min. sect.	A. D.	0.87	37.67	54.31	0.012	7.15	2.36	75.72	5.34	8.08	1.35	14050	13790	4.97
22	Cons. No. 45 (Murray)	Marion.	Pittsburgh, Min. sect.	A. R.	0.87	37.67	54.31	0.012	7.15	2.36	75.72	5.34	8.08	1.35	14050	13790	4.97
23	Catawba Coal Co.	Marion.	Pittsburgh, Min. sect.	A. D.	0.97	35.12	57.99	0.025	5.92	1.18	76.82	5.21	9.47	1.40	14170	13729	4.99
23	Catawba Coal Co.	Marion.	Pittsburgh, Min. sect.	A. R.	1.50	34.93	57.68	0.025	5.89	1.17	76.40	5.24	9.91	1.39	14100	13650	4.84
24	Pittsburgh Steam Coal Co.	Marion.	Pittsburgh, Min. sect.	A. D.	0.93	36.75	55.79	0.006	6.53	1.73	77.01	5.25	8.11	1.37	14159	13900	5.26
24	Pittsburgh Steam Coal Co.	Marion.	Pittsburgh, Min. sect.	A. R.	1.21	36.65	55.63	0.006	6.51	1.73	76.80	5.27	8.32	1.37	14110	13860	5.18
25	Va. & Pgh. C. & C. Co. (Morgan)	Marion.	Pittsburgh, Min. sect.	A. D.	1.05	37.00	56.30	0.019	5.65	1.55	77.94	5.21	8.23	1.42	14310	13990	5.62
25	Va. & Pgh. C. & C. Co. (Morgan)	Marion.	Pittsburgh, Min. sect.	A. R.	1.91	36.68	55.81	0.019	5.60	1.54	77.26	5.27	8.92	1.41	14190	13870	5.32
26	Cons. No. 24 (Montana)	Marion.	Pittsburgh, Min. sect.	A. D.	1.00	37.16	55.44	0.005	6.40	1.47	76.93	5.01	8.83	1.36	14130	13670	5.05
26	Cons. No. 24 (Montana)	Marion.	Pittsburgh, Min. sect.	A. R.	1.37	37.02	55.23	0.005	6.38	1.46	76.64	5.03	9.14	1.35	14080	13620	4.94

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
27	Federal C. & C. Co.	Marion	Pittsburgh, Min. sect.	A. D.	0.80	35.61	56.99	0.086	6.60	1.79	77.42	5.02	7.64	1.53	14168	13857	5.44
27	Federal C. & C. Co.	Marion	Pittsburgh, Min. sect.	A. R.	1.39	35.40	56.65	0.086	6.56	1.78	76.96	5.06	8.12	1.52	14083	13774	5.24
27	Federal C. & C. Co.	Marion	Pittsburgh bottom	A. D.	0.71	35.03	54.71	0.061	9.55	3.75	73.88	4.88	6.66	1.28	13505	13409	4.55
27	Federal C. & C. Co.	Marion	Pittsburgh bottom	A. R.	1.75	34.66	54.14	0.061	9.45	3.71	73.11	4.94	7.53	1.26	13363	13269	4.56
28	New Central Coal Co.	Marion	Pittsburgh, Min. sect.	A. D.	0.86	35.49	56.28	0.049	7.37	2.05	77.07	4.96	7.02	1.53	14128	13823	5.36
28	New Central Coal Co.	Marion	Pittsburgh, Min. sect.	A. R.	2.67	34.84	55.25	0.048	7.24	2.01	75.66	5.07	8.52	1.50	13860	13570	4.80
29	Dakota C. & C. Co.	Marion	Pittsburgh, Min. sect.	A. D.	0.52	37.26	55.99	0.024	6.23	1.21	77.52	5.36	8.17	1.51	14470	14020	5.38
29	Dakota C. & C. Co.	Marion	Pittsburgh, Min. sect.	A. R.	0.80	37.16	55.83	0.024	6.21	1.20	77.30	5.38	8.41	1.50	14430	13980	5.28
30	Jamison C. & C. Co. No. 9 (South A)	Marion	Pittsburgh, Min. sect.	A. D.	0.87	37.51	55.30	0.006	6.32	1.63	76.57	5.24	8.73	1.51	14040	13780	5.09
30	Jamison C. & C. Co. No. 9 (South A)	Marion	Pittsburgh, Min. sect.	A. R.	1.13	37.42	55.15	0.006	6.30	1.62	76.37	5.26	8.95	1.50	14000	13750	5.01
30	Jamison C. & C. Co. No. 9 (North A)	Marion	Pittsburgh, Min. sect.	A. D.	0.79	37.80	55.08	0.020	6.33	2.05	77.03	5.27	7.85	1.47	14080	13930	5.43
30	Jamison C. & C. Co. No. 9 (North A)	Marion	Pittsburgh, Min. sect.	A. R.	0.99	37.73	54.96	0.020	6.32	2.05	76.88	5.28	8.00	1.47	14050	13900	5.37
31	Jamison C. & C. Co. No. 8 (Left extension)	Marion	Pittsburgh, Min. sect.	A. D.	0.72	36.29	56.77	0.012	6.22	0.87	77.44	5.53	8.60	1.34	14060	14070	5.23
31	Jamison C. & C. Co. No. 8 (Left extension)	Marion	Pittsburgh, Min. sect.	A. R.	1.04	36.17	56.59	0.012	6.20	0.87	77.19	5.54	8.86	1.34	14020	14030	5.13
31	Jamison C. & C. Co. No. 8 (Main heading)	Marion	Pittsburgh, Min. sect.	A. D.	0.68	35.76	58.02	0.005	5.54	0.98	78.03	5.37	8.76	1.32	14090	14040	5.46
31	Jamison C. & C. Co. No. 8 (Main heading)	Marion	Pittsburgh, Min. sect.	A. R.	1.27	35.55	57.68	0.005	5.50	0.98	77.57	5.40	9.24	1.31	14010	13960	5.26
32	Jamison C. & C. Co. No. 7 (South A)	Marion	Pittsburgh, Min. sect.	A. D.	0.52	38.36	53.14	0.009	7.98	2.31	75.23	5.10	7.97	1.41	13930	13580	4.72
32	Jamison C. & C. Co. No. 7 (South A)	Marion	Pittsburgh, Min. sect.	A. R.	0.83	38.24	52.97	0.009	7.96	2.30	75.00	5.11	8.22	1.41	13890	13540	4.63

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D."=air dried, and "A. R." =as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon	Phosphorus.	Ash.	Sulphur.	Carbon	Hydrogen.	Oxygen.	Nitrogen.			
32	Jamison C. & C. Co. No. 7 (North A)	Marion	Pittsburgh, Min. sect.	A. D.	0.45	37.82	55.35	0.014	6.38	1.80	78.66	5.02	6.60	1.54	14210	14120	6.06
32	Jamison C. & C. Co. No. 7 (North A)	Marion	Pittsburgh, Min. sect.	A. R.	0.55	37.78	55.30	0.014	6.37	1.79	78.58	5.03	6.68	1.54	14200	14110	6.02
33	Cons. No. 38 (Shaft)	Marion	Pittsburgh, Min. sect.	A. D.	0.87	37.60	54.25	0.005	7.28	2.54	75.34	5.14	8.28	1.42	13960	13610	4.84
33	Cons. No. 38 (Shaft)	Marion	Pittsburgh, Min. sect.	A. R.	1.03	37.53	54.17	0.005	7.27	2.54	75.22	5.15	8.40	1.42	13940	13590	4.80
34	Pat Hoge	Marion	Pittsburgh, Min. sect.	A. D.	0.97	34.91	57.88	0.032	6.24	2.34	76.72	5.22	8.20	1.28	14202	13858	5.31
34	Pat Hoge	Marion	Pittsburgh, Min. sect.	A. R.	1.93	34.57	57.32	0.032	6.18	2.31	75.99	5.27	8.99	1.26	14064	13724	5.01
35	Cons. No. 56 (Gaston)	Marion	Pittsburgh, Min. sect.	A. D.	0.90	36.48	56.24	0.017	6.38	1.40	76.67	5.00	9.21	1.34	14110	13600	4.92
35	Cons. No. 56 (Gaston)	Marion	Pittsburgh, Min. sect.	A. R.	1.50	36.25	55.91	0.017	6.34	1.39	76.20	5.04	9.70	1.33	14030	13520	4.75
36	Cons. No. 26 (New Eng.)	Marion	Pittsburgh, Min. sect.	A. D.	0.54	36.98	55.03	0.007	7.45	2.54	77.71	5.32	5.65	1.33	14220	14270	5.93
36	Cons. No. 26 (New Eng.)	Marion	Pittsburgh, Min. sect.	A. R.	0.77	36.90	54.90	0.007	7.43	2.53	77.53	5.33	5.85	1.33	14190	14240	5.84
37	Robinson Bros.	Marion	Pittsburgh, Min. sect.	A. D.	0.85	36.86	53.90	0.018	8.39	2.53	73.22	5.14	9.34	1.38	13780	13200	4.13
37	Robinson Bros.	Marion	Pittsburgh, Min. sect.	A. R.	1.77	36.52	53.40	0.018	8.31	2.51	72.54	5.19	10.08	1.37	13650	13080	3.94
38	Va. & Pgh. C. & C. Co. (Kingmont)	Marion	Pittsburgh, Min. sect.	A. D.	0.89	36.03	58.76	0.009	4.32	1.11	78.64	5.18	9.37	1.38	14570	13970	5.74
38	Va. & Pgh. C. & C. Co. (Kingmont)	Marion	Pittsburgh, Min. sect.	A. R.	1.14	35.94	58.61	0.009	4.31	1.11	78.44	5.20	9.56	1.38	14530	13940	5.66
39	Phillips Coal Co.	Marion	Pittsburgh, Min. sect.	A. D.	0.82	38.31	54.57	0.009	6.30	1.94	76.36	5.26	8.72	1.42	14090	13770	5.08
39	Phillips Coal Co.	Marion	Pittsburgh, Min. sect.	A. R.	1.16	38.18	54.38	0.009	6.28	1.93	76.11	5.28	8.99	1.41	14040	13720	4.98
40	Cons. No. 43 (Monongah No. 6)	Marion	Pittsburgh, Min. sect.	A. D.	0.91	34.62	58.23	0.019	6.24	1.36	76.61	5.24	9.18	1.37	14200	13730	4.97
40	Cons. No. 43 (Monongah No. 6)	Marion	Pittsburgh, Min. sect.	A. R.	1.21	34.52	58.05	0.019	6.22	1.35	76.38	5.25	9.42	1.37	14150	13690	4.88
41	Cons. No. 22 (Monongah (No. 7)	Marion	Pittsburgh, Min. sect.	A. D.	1.20	35.45	57.87	0.007	5.48	1.50	76.72	5.10	9.82	1.38	14150	13630	5.01
41	Cons. No. 22 (Monongah (No. 7)	Marion	Pittsburgh, Min. sect.	A. R.	1.63	35.29	57.62	0.007	5.46	1.49	76.38	5.13	10.17	1.37	14090	13570	4.89

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
42	Cons. No. 22 (Monongah (No. 5)	Marion	Pittsburgh, Min. sect.	A. D.	0.77	36.64	56.57	0.001	6.02	1.57	76.60	5.05	9.40	1.36	14050	13610	4.97
42	Cons. No. 22 (Monongah (No. 5)	Marion	Pittsburgh, Min. sect.	A. R.	0.99	36.56	56.44	0.011	6.01	1.57	76.43	5.06	9.57	1.36	14020	13580	4.91
43	Cons. No. 53 (Shaver)	Marion	Pittsburgh, Min. sect.	A. D.	0.73	37.44	55.96	0.017	5.87	1.58	76.93	5.24	8.95	1.43	14280	13810	5.19
43	Cons. No. 53 (Shaver)	Marion	Pittsburgh, Min. sect.	A. R.	0.88	37.38	55.88	0.017	5.86	1.58	76.82	5.25	9.06	1.43	14260	13790	5.15
44	Cons. No. 63 (Monongah No. 8)	Marion	Pittsburgh, Min. sect.	A. D.	0.48	34.82	54.70	0.034	10.00	0.74	73.75	4.98	9.17	1.36	13270	13130	3.85
44	Cons. No. 63 (Monongah No. 8)	Marion	Pittsburgh, Min. sect.	A. R.	0.88	34.68	54.48	0.034	9.96	0.74	73.46	5.00	9.49	1.35	13220	13080	3.78
45	Cons. No. 34 (Monongah No. 3)	Marion	Pittsburgh, Min. sect.	A. D.	0.68	36.61	57.18	0.044	5.53	0.80	77.75	5.24	9.25	1.43	14150	13880	5.26
45	Cons. No. 34 (Monongah No. 3)	Marion	Pittsburgh, Min. sect.	A. R.	1.16	36.44	56.90	0.044	5.50	0.80	77.38	5.27	9.63	1.42	14080	13820	5.11
46	Cons. No. 68 (Pennois)	Marion	Pittsburgh, Min. sect.	A. D.	0.98	36.04	57.59	0.051	5.39	0.89	77.48	5.15	9.57	1.52	14190	13770	5.17
46	Cons. No. 68 (Pennois)	Marion	Pittsburgh, Min. sect.	A. R.	1.39	35.90	57.34	0.051	5.37	0.89	77.17	5.17	9.88	1.52	14140	13720	5.06
47	H. B. Clark Coal Co. (No. 6)	Marion	Pittsburgh, Min. sect.	A. D.	0.93	36.24	58.51	0.028	4.32	1.02	77.93	5.45	9.99	1.29	14180	13980	5.45
47	H. B. Clark Coal Co. (No. 6)	Marion	Pittsburgh, Min. sect.	A. R.	1.50	36.04	58.17	0.028	4.29	1.01	77.48	5.48	10.46	1.28	14100	13900	5.25
48	H. B. Clark Coal Co. (No. 3)	Marion	Pittsburgh, Min. sect.	A. D.	0.99	37.05	57.72	0.036	4.24	0.88	78.26	5.08	10.24	1.30	14280	13780	5.40
48	H. B. Clark Coal Co. (No. 3)	Marion	Pittsburgh, Min. sect.	A. R.	1.66	36.80	57.33	0.036	4.21	0.87	77.73	5.12	10.78	1.29	14180	13680	5.19
49	H. B. Clark Coal Co. (No. 2)	Marion	Pittsburgh, Min. sect.	A. D.	0.90	36.53	58.02	0.025	4.55	0.99	77.53	5.17	10.40	1.36	14230	13720	5.19
49	H. B. Clark Coal Co. (No. 2)	Marion	Pittsburgh, Min. sect.	A. R.	1.77	36.20	57.52	0.025	4.51	0.98	76.84	5.21	11.11	1.35	14110	13600	4.92
50	Kilarm C. & C. Co. (No. 2)	Marion	Pittsburgh, Min. sect.	A. D.	1.18	37.21	56.07	0.037	5.54	1.54	76.74	5.08	9.83	1.27	14170	13610	4.99
50	Kilarm C. & C. Co. (No. 2)	Marion	Pittsburgh, Min. sect.	A. R.	2.34	36.78	55.40	0.037	5.48	1.52	75.84	5.13	10.78	1.25	14010	13450	4.66
51	Kilarm C. & C. Co. (No. 1)	Marion	Pittsburgh, Min. sect.	A. D.	1.00	37.54	54.71	0.010	6.75	2.99	74.20	4.91	9.89	1.26	13880	13200	4.46
51	Kilarm C. & C. Co. (No. 1)	Marion	Pittsburgh, Min. sect.	A. D.	1.50	37.35	54.43	0.010	6.72	2.98	73.82	4.95	10.28	1.25	13810	13140	4.34
52	Cons. No. 59 (Anderson)	Marion	Pittsburgh, Min. sect.	A. D.	0.95	37.93	56.15	0.038	4.97	1.26	76.54	5.21	10.52	1.50	14240	13600	4.94

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal.	Calcu'ated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
52	Cons. No. 59 (Anderson)...	Marion.....	Pittsburgh, Min. sect..	A. R.	1.20	37.83	56.01	0.038	4.96	1.26	76.35	5.23	10.70	1.50	14210	13570	4.88
53	Cons. No. 36 (Highland)..	Marion.....	Pittsburgh, Min. sect..	A. D.	1.17	38.20	55.18	0.018	5.45	2.25	76.67	5.11	9.14	1.38	13960	13700	5.25
53	Cons. No. 36 (Highland)..	Marion.....	Pittsburgh, Min. sect..	A. R.	1.56	38.05	54.96	0.018	5.43	2.24	76.37	5.13	9.45	1.38	13910	13650	5.13
54	Cons. No. 47 (Middleton)..	Marion.....	Pittsburgh, Min. sect..	A. D.	0.84	37.92	52.97	0.012	8.27	2.90	73.62	5.14	8.72	1.35	13780	13420	4.33
54	Cons. No. 47 (Middleton)..	Marion.....	Pittsburgh, Min. sect..	A. R.	1.23	37.77	52.77	0.012	8.23	2.88	73.34	5.16	9.05	1.34	13730	13370	4.25
55	Cons. No. 28 (Chiefton)...	Marion.....	Pittsburgh, Min. sect..	A. D.	0.77	36.64	57.02	0.038	5.57	0.93	77.32	5.28	9.42	1.48	14150	13830	5.16
55	Cons. No. 28 (Chiefton)...	Marion.....	Pittsburgh, Min. sect..	A. R.	1.19	36.49	56.78	0.038	5.54	0.93	77.00	5.30	9.76	1.47	14090	13770	5.03
56	Cons. No. 84 (Paradise)...	Marion.....	Pittsburgh, Min. sect..	A. D.	0.87	37.35	55.21	0.024	6.57	1.42	76.30	5.26	9.06	1.39	14200	13720	4.88
56	Cons. No. 84 (Paradise)...	Marion.....	Pittsburgh, Min. sect..	A. R.	3.95	36.19	53.49	0.024	6.37	1.38	73.92	5.44	11.54	1.35	13760	13390	4.07
57	Cons. No. 67 (Hutchinson).	Marion.....	Pittsburgh, Min. sect..	A. D.	0.99	36.55	56.23	0.027	6.23	1.40	77.47	5.29	8.22	1.39	14030	13970	5.36
57	Cons. No. 67 (Hutchinson).	Marion.....	Pittsburgh, Min. sect..	A. R.	1.50	36.36	55.94	0.027	6.20	1.39	77.08	5.32	8.63	1.39	13960	13900	5.20
58	Four States C. & C. Co. (Annabelle) No. 2 Butt, East	Marion.....	Pittsburgh, Min. sect..	A. D.	0.96	37.22	55.99	0.024	5.83	1.61	76.11	5.04	10.02	1.39	14040	13490	4.78
58	Four States C. & C. Co. (Annabelle) No. 2 Butt, East	Marion.....	Pittsburgh, Min. sect..	A. R.	1.47	37.03	55.70	0.024	5.80	1.60	75.72	5.07	10.43	1.38	13970	13420	4.67
58	Four States C. & C. Co. (Annabelle) No. 1 Butt, East	Marion.....	Pittsburgh, Min. sect..	A. D.	0.74	37.17	55.71	0.014	6 38	1.33	76.26	5.03	9.64	1.36	14010	13520	4.76
58	Four States C. & C. Co. (Annabelle) No. 1 Butt, East	Marion.....	Pittsburgh, Min. sect..	A. R.	1.29	36.96	55.41	0.014	6.34	1.32	75.84	5.06	10.09	1.35	13940	13440	4.62
58	Four States C. & C. Co. (Annabelle) Left Main Dip	Marion.....	Pittsburgh, Min. sect..	A. D.	0.62	37.97	53.42	0.041	7.99	1.62	74.83	4.82	9.39	1.35	13720	13210	4.31
58	Four States C. & C. Co. (Annabelle) Left Main Dip	Marion.....	Pittsburgh, Min. sect..	A. R.	1.03	37.82	53.19	0.041	7.96	1.61	74.53	4.84	9.72	1.34	13670	13160	4.22

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.					Calorimeter B. T. U. for 1 lb. of coal.	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.				
59	Harrison Coal Co.	Taylor	Pittsburgh, Min. sect.	A. D.	1.03	38.01	54.71	0.020	6.25	2.79	76.01	5.48	8.16	1.31		14270	13930	5.27
59	Harrison Coal Co.	Taylor	Pittsburgh, Min. sect.	A. R.	1.31	37.90	54.56	0.020	6.23	2.78	75.79	5.49	8.41	1.30		14230	13890	5.18
60	Rosemont Coal Co.	Taylor	Pittsburgh, Min. sect.	A. D.	0.93	39.13	53.86	0.012	6.08	3.17	76.64	5.54	7.27	1.30		14280	14150	5.74
60	Rosemont Coal Co.	Taylor	Pittsburgh, Min. sect.	A. R.	1.34	38.97	53.64	0.012	6.05	3.15	76.33	5.56	7.62	1.29		14220	14090	5.58
61	Pittsvein Coal Co.	Taylor	Pittsburgh, Min. sect.	A. D.	0.79	37.69	55.38	0.037	6.14	3.17	76.86	5.35	7.19	1.27		14340	14070	5.77
61	Pittsvein Coal Co.	Taylor	Pittsburgh, Min. sect.	A. R.	1.18	37.54	55.16	0.037	6.12	3.17	76.56	5.37	7.52	1.26		14280	14020	5.62
62	T. B. Davis Mine	Taylor	Pittsburgh, Min. sect.	A. D.	0.87	36.99	55.66	0.038	6.48	3.54	75.14	5.22	8.21	1.41		14170	13680	5.12
62	T. B. Davis Mine	Taylor	Pittsburgh, Min. sect.	A. R.	1.08	36.92	55.54	0.038	6.46	3.53	74.98	5.23	8.39	1.41		14140	13650	5.05
63	McGraw Coal Co. (N. Y.)	Taylor	Pittsburgh, Min. sect.	A. D.	0.33	38.88	53.67	0.035	7.12	3.45	75.22	5.26	7.68	1.27		14400	13820	5.08
63	McGraw Coal Co. (N. Y.)	Taylor	Pittsburgh, Min. sect.	A. R.	0.33	38.88	53.67	0.035	7.12	3.45	75.22	5.26	7.68	1.27		14400	13820	5.08
64	Grafton C. & C. Co.	Taylor	Pittsburgh, Min. sect.	A. D.	0.48	36.75	56.91	0.026	5.86	1.88	77.92	5.35	7.55	1.44		14400	14140	5.81
64	Grafton C. & C. Co.	Taylor	Pittsburgh, Min. sect.	A. R.	0.75	36.65	56.76	0.026	5.84	1.87	77.71	5.36	7.79	1.43		14400	14100	5.70
65	Maryland C. Co. (Wendel No. 4)	Taylor	Pittsburgh, Min. sect.	A. D.	0.90	35.77	55.81	0.035	7.52	3.45	75.94	5.34	6.41	1.34		13920	14000	5.45
65	Maryland C. Co. (Wendel No. 4)	Taylor	Pittsburgh, Min. sect.	A. R.	0.94	35.76	55.79	0.035	7.51	3.45	75.91	5.34	6.45	1.34		13910	13990	5.44
66	Maryland C. Co. (Wendel No. 1)	Taylor	Pittsburgh, Min. sect.	A. D.	0.55	35.52	57.25	0.059	6.68	1.15	74.74	5.86	10.19	1.38		14150	13760	4.43
66	Maryland C. Co. (Wendel No. 1)	Taylor	Pittsburgh, Min. sect.	A. R.	0.98	35.37	57.00	0.059	6.65	1.14	74.42	5.84	10.58	1.37		14090	13700	4.32
67	Maryland C. Co. (Wendel No. 5)	Taylor	Pittsburgh, Min. sect.	A. D.	0.47	36.75	55.32	0.023	7.46	1.95	75.48	4.82	8.94	1.35		14040	13360	4.60
67	Maryland C. Co. (Wendel No. 5)	Taylor	Pittsburgh, Min. sect.	A. R.	0.74	36.65	55.17	0.023	7.44	1.94	75.28	4.84	9.16	1.34		14000	13320	4.53
68	John Robinson (Kunst)	Taylor	Pittsburgh, Min. sect.	A. D.	0.66	35.56	54.74	0.095	9.04	3.02	74.26	5.07	7.22	1.39		13830	13520	4.57
68	John Robinson (Kunst)	Taylor	Pittsburgh, Min. sect.	A. R.	0.83	35.50	54.65	0.095	9.02	3.01	74.14	5.08	7.36	1.39		13810	13500	4.53
	Average		Pittsburgh, Min. sect.	A. D.	0.82	36.82	55.87	0.024	6.49	1.88	76.52	5.18	8.55	1.38		14114	13760	5.09
	Average		Pittsburgh, Min. sect.	A. R.	1.34	36.63	55.62	0.023	6.41	1.91	76.17	5.21	8.93	1.37		14048	13705	4.97

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

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					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
69	Crop, Public road	Taylor	Lit. Clksburg Min. sect	A. R.	6.59	29.43	45.23	0.106	18.75	1.05	57.72	4.20	17.58	0.70	9547	9684	1.59
69A	Regal Coal Co.	Monongalia.	Elk Lick, Min. sect...	A. R.	0.43	34.92	48.60	0.032	16.05	3.30	68.10	4.52	6.88	1.15	12660	12310	2.97
70	John Williams	Taylor	Bakerstown, Min. sect.	A. R.	0.84	31.84	59.96	0.044	7.36	1.82	76.50	5.26	7.74	1.32	14130	13860	5.07
71	J. J. Shreyer	Taylor	Bakerstown, Min. sect.	A. R.	1.06	32.07	57.39	0.010	9.48	3.33	76.05	5.28	4.56	1.30	13740	14120	5.42
	Average	Taylor	Bakerstown, Min. sect.	A. R.	0.95	31.96	58.67	0.027	8.42	2.57	76.28	5.27	6.15	1.31	13935	13990	5.24
72	Crop, Public road	Marion	Brush Creek Min. sect	A. R.	1.08	37.00	53.46	0.013	8.46	2.41	74.33	5.17	8.51	1.12	13820	13460	4.38
73	Chess Estate	Monongalia.	U. Freeport, Min. sect.	A. R.	1.57	29.98	62.74	0.024	5.71	0.61	78.46	4.86	9.13	1.23	14380	13740	5.29
74	Elkins C. & C. Co. No. 1 (Richard)	Monongalia.	U. " Cannel slate.	A. D.	0.33	16.13	37.84	0.015	45.70	0.41	.....	.....	.....	.....	.....	.....	.....
74	Elkins C. & C. Co. No. 1 (Richard)	Monongalia.	U. Freeport, Min. sect.	A. D.	1.30	34.80	56.42	0.025	7.48	0.99	77.73	5.00	7.69	1.11	13883	13851	5.12
75	Connellsville Basin Coke Co.	Monongalia.	U. Freeport, Min. sect.	A. D.	1.70	28.33	63.90	0.005	6.07	1.22	80.02	4.90	6.80	0.99	14135	14200	6.22
76	Terence Stewart	Monongalia.	U. Freeport, Min. sect.	A. R.	1.12	31.24	61.93	0.025	5.71	0.72	78.96	4.84	8.61	1.16	14350	13880	5.51
77	Baldwin Weaver	Monongalia.	U. Freeport, Min. sect.	A. R.	3.43	29.24	60.48	0.023	6.85	0.66	73.43	5.20	12.45	1.41	13260	12960	3.80
78	O. C. Johnson	Monongalia.	U. Freeport, Min. sect.	A. R.	1.46	29.22	57.04	0.036	12.28	1.38	73.90	3.94	7.34	1.16	13230	12680	3.77
79	Daniel Morris	Monongalia.	U. Freeport, Min. sect.	A. R.	2.19	28.94	54.32	0.117	14.55	0.75	68.01	4.50	11.11	1.08	12400	11850	2.65
80	U. G. Jennings	Taylor	U. Freeport, Min. sect.	A. R.	1.14	32.19	57.52	0.023	9.15	1.50	75.63	5.18	7.35	1.19	13900	13700	4.58
81	Edith J. Harvey	Taylor	U. Freeport, Min. sect.	A. R.	1.02	28.49	58.63	0.045	11.86	1.34	76.59	4.32	4.73	1.16	13440	13510	4.62
	Average		U. Freeport, Min. sect.	A. D.	1.50	31.57	60.16	0.015	6.77	1.11	78.88	4.95	7.24	1.05	14009	14025	5.63
	Average		U. Freeport, Min. sect.	A. R.	1.70	29.90	58.95	0.042	9.45	0.99	75.00	4.69	8.67	1.20	13566	13189	4.14
82	Emory Jones	Monongalia.	U.Kittanning Min. sect	A. R.	1.10	30.11	59.47	0.052	9.32	1.42	75.11	4.85	7.84	1.46	13840	13380	4.38
83	W. A. C. Corrothers	Taylor	U.Kittanning Min. sect	A. R.	1.23	30.58	56.30	0.041	11.89	4.43	72.81	4.69	5.06	1.12	13190	13290	4.30
84	Winona C. & C. Co. No. 1.	Taylor	U.Kittanning Min. sect	A. D.	0.62	31.08	54.65	0.008	13.65	3.29	70.41	4.74	6.74	1.17	13040	12790	3.45
84	Winona C. & C. Co. No. 1.	Taylor	U.Kittanning Min. sect	A. R.	1.06	30.94	54.41	0.008	13.59	3.28	70.10	4.76	7.11	1.16	12980	12730	3.39
85	C. N. Mason	Taylor	U.Kittanning Min. sect	A. R.	1.38	30.24	54.97	0.008	13.41	3.30	71.11	4.75	6.14	1.29	13040	12950	3.63
	Average		U.Kittanning Min. sect	A. R.	1.19	30.47	56.29	0.027	12.05	3.11	72.28	4.76	6.54	1.26	13263	13088	3.89

TABLE OF COAL ANALYSES.

(Under the heading, "Condition of Sample", "A. D." air dried, and "A. R." as received).

Mine No. on Map	Mine.	County.	Horizon.	Condition of Sample.	Proximate.				Common to both.		Ultimate.				Calorimeter B. T. U. for 1 lb. of coal	Calculated B. T. U. for 1 lb. of coal.	Carbon divided by Oxygen + Ash.
					Moisture.	Volatile Matter.	Fixed Carbon.	Phosphorus.	Ash.	Sulphur.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.			
86	J. H. McClaren	Monongalia.	L. Kitt'ing, Min. sect.	A.R.	1.50	32.57	59.22	0.005	6.71	2.07	77.59	4.80	7.49	1.34	14320	13780	5.46
87	Joseph Repport	Monongalia.	L. Kitt'ing, Min. sect.	A.R.	1.43	29.85	58.61	0.006	10.11	2.35	74.60	5.10	6.56	1.28	13680	13600	4.48
88	Unknown	Monongalia.	L. Kitt'ing, Min. sect.	A.R.	1.82	30.28	55.02	0.011	12.88	7.63	67.91	5.01	5.42	1.15	12860	12860	3.71
89	Samuel Frederick	Monongalia.	L. Kitt'ing, Min. sect.	A.R.	1.80	29.19	57.29	0.085	11.72	1.08	74.51	4.43	7.03	1.23	13030	13080	3.97
90	Marcellus Jolliffe	Marion	L. Kitt'ing, Min. sect.	A.R.	1.18	28.89	54.47	0.010	15.46	2.68	70.17	4.80	5.77	1.12	12670	12850	3.31
91	Owen Vincent	Marion	L Kitt'ing, Min. sect.	A.R.	1.51	38.92	45.20	0.034	14.37	1.15	70.77	5.14	7.42	1.15	12970	12950	3.25
92	Jacob Rogers	Marion	L. Kittanning, Cannel	A.R.	0.46	26.98	47.21	0.030	25.35	0.77	63.01	4.31	5.57	0.99	11690	11440	2.04
93	Jacob Rogers	Marion	L. Kitt'ing, U. bench.	A.R.	0.79	27.49	52.22	0.015	19.50	1.68	66.58	4.32	6.84	1.08	12300	11900	2.53
93	Jacob Rogers	Marion	L. Kittanning, Cannel	A.R.	0.60	25.69	41.66	0.064	32.05	1.90	56.71	4.06	4.30	0.98	10330	10510	1.56
94	Chas. Sapp	Taylor	L. Kitt'ing, Min. sect.	A.R.	0.70	29.75	62.17	0.012	7.38	1.85	77.26	4.92	7.45	1.14	14800	13790	5.21
95	Winona C. & C. Co. No. 2.	Taylor	L. Kitt'ing, Min. sect.	A.D.	0.79	30.83	57.66	0.019	10.72	2.58	74.19	4.84	6.44	1.23	13600	13400	4.32
95	Winona C. & C. Co. No. 2.	Taylor	L. Kitt'ing, Min. sect.	A.R.	1.53	30.60	57.23	0.019	10.64	2.56	73.63	4.88	7.07	1.22	13500	13300	4.21
96	Harvey Phillips	Barbour	L. Kitt'ing, Min. sect.	A.R.	0.76	31.49	62.43	0.012	5.32	1.46	81.78	5.05	5.07	1.32	14870	14700	4.16
97	Sterling Coal Co.	Taylor	L. Kitt'ing, Min. sect.	A.D.	0.95	29.21	60.91	0.008	8.93	3.38	77.77	4.94	3.96	1.02	14324	14202	6.03
97	Sterling Coal Co.	Taylor	L. Kitt'ing, Min. sect.	A.R.	1.47	29.06	60.58	0.008	8.89	3.36	77.37	5.00	4.37	1.01	14250	14152	5.83
98	Overholt C. & C. Co.	Taylor	L. Kitt'ing, Min. sect.	A.D.	0.44	31.82	58.27	0.021	9.47	1.94	75.80	4.97	6.54	1.28	13930	13680	4.73
98	Overholt C. & C. Co.	Taylor	L. Kitt'ing, Min. sect.	A.R.	10.52	28.60	52.37	0.021	8.51	1.74	68.12	5.60	14.88	1.15	12520	12290	2.91
	Average		L. Kitt'ing, Min. sect.	A.D.	0.73	30.62	58.95	0.016	9.70	2.63	75.92	4.92	5.65	1.18	13951	13761	4.95
	Average		L. Kitt'ing, Min. sect.	A.R.	2.20	30.84	56.78	0.020	10.18	2.54	73.97	4.98	7.14	1.19	13543	13395	4.27
	Average	Marion	L. Kitt'ing, Cannel.	A.R.	0.53	26.34	44.43	0.047	28.70	1.33	59.86	4.19	4.93	0.99	11010	10475	1.79
99	Z. Gibson	Preston	Clarion, Min. sect.	A.R.	0.85	28.64	59.63	0.044	10.88	3.27	74.73	4.89	5.10	1.13	13800	13640	4.68
100	Jacob Keys	Monongalia.	U. Mercer, Min. sect.	A.R.	1.88	24.61	51.34	0.023	22.17	0.72	64.14	3.79	8.20	0.98	11160	11080	2.11
101	B. & N. R. R.	Taylor	U. Mercer, U. bench.	A.R.	0.92	30.59	62.75	0.008	5.74	1.46	77.99	4.99	8.51	1.31	14320	13840	5.47
101	B. & N. R. R.	Taylor	U. Mercer, L. bench.	A.R.	1.15	27.00	54.36	0.012	17.49	0.69	68.16	4.23	8.30	1.13	12240	11920	2.64

Page Reference to Detailed Description and Section of Coal Mines Listed in Preceding Table.

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4	614-H	Geo. C. Wright	202
5	643-H	Unknown	205
6	644-H	Crop, public road	211
7	618-H	Clark Wade	234
7A	816-H	Chas. Brand	235
8	620-H	Wm. Glasscock	239
9	613-H	John Statler	240
10	647-H	C. J. Martin	240
11	649-H	Monongahela Valley Traction Company	242
12	642-H	W. I. Nutter	245
13	641-H	Baltimore & Ohio Railroad	253-4
*20	596-H	T. W. Kinnan	432
14	631-H	S. Z. T. Martin	736
15	721-H	Parker Run Coal & Coke Co	661
15A	444-H	Dakota Coal & Coke Co	661
15B	815-H	A. H. Tait	262
*20	595-H	T. W. Kinnan	432
16	635-H	Wm. Robinson	680
17	Vol. II(A) p. 668	Elkins Coal & Coke Co. No. 5	680
18	735-H	Great Scott Coal & Coke Co	680
19	737-H	Antler Coal Co	681
20	734-H	Consolidation Coal Co. No. 30 (Beechwood)	681
21	732-H	Pittsburgh Steam Coal Co	682
22	731-H	Consolidation Coal Co. No. 45 (Murray)	682
23	730-H	Catawba Coal Co	683
24	729-H	Pittsburgh Steam Coal Co	683
25	728-H	Virginia & Pittsburgh Coal & Coke Co. (Morgan)	684 (711)
26	727-H	Consolidation Coal Co. No. 24 (Montana)	684
27	441-H	Federal Coal & Coke Co	685
28	443-H	New Central Coal Co	685
29	720-H	Dakota Coal & Coke Co	686
30	723-H	Jamison Coal & Coke Co. No. 9	686-7
31	715-H	Jamison Coal & Coke Co. No. 8	687-8
32	725-H	Jamison Coal & Coke Co. No. 7	688
33	722-H	Consolidation Coal Co. No. 38 (Shaft)	690
34	445-H	Pat Hoge	691
35	702-H	Consolidation Coal Co. No. 56 (Gaston)	691
36	719-H	Consolidation Coal Co. No. 26 (New England)	691
37	718-H	Robinson Bros	692
38	714-H	Virginia & Pittsburgh Coal & Coke Co. (Kingmont)	692
39	717-H	Phillips Coal Co	693
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*Well number.

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42	700-H	Consolidation Coal Co. No. 22 (Monongah No. 5)	695
43	699-H	Consolidation Coal Co. No. 53 (Shaver)	695
44	695-H	Consolidation Coal Co. No. 63 (Monongah No. 8)	696
45	694-H	Consolidation Coal Co. No. 34 (Monongah No. 3)	696
46	693-H	Consolidation Coal Co. No. 68 (Pennois)	697
47	711-H	Harry B. Clark Coal Co. No. 6	698
48	709-H	Harry B. Clark Coal Co. No. 3	698
49	710-H	Harry B. Clark Coal Co. No. 2	698
50	708-H	Kilarm Coal & Coke Co. No. 2	699
51	707-H	Kilarm Coal & Coke Co. No. 1	699
52	692-H	Consolidation Coal Co. No. 59 (Anderson)	700
53	691-H	Consolidation Coal Co. No. 36 (Highland)	700
54	690-H	Consolidation Coal Co. No. 47 (Middleton)	701
55	689-H	Consolidation Coal Co. No. 28 (Chiefton)	701
56	688-H	Consolidation Coal Co. No. 84 (Paradise)	702
57	687-H	Consolidation Coal Co. No. 67 (Hutchinson)	702
58	703-H	Four States Coal & Coke Co. (Annabelle)	703-4
59	676-H	Harrison Coal Co	705
60	677-H	Rosemont Coal Co	705
61	678-H	Pittsvein Coal Co	706
62	679-H	T. B. Davis Mine	706
63	684-H	McGraw Coal Co. (New York)	707
64	683-H	Grafton Coal & Coke Co	707
65	680-H	Maryland Coal Co. of W. Va. (Wendel No. 4)	708
66	681-H	Maryland Coal Co. of W. Va. (Wendel No. 1)	708
67	682-H	Maryland Coal Co. of W. Va. (Wendel No. 5)	708
68	686-H	John Robinson (Kunst)	709
69	563-H	Crop, public road	277
69A	814-H	Regal Coal Co	284
70	581-H	John Williams	304
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72	572-H	Crop, public road	315
73	636-H	Chess Estate	714
74	Bull. 2 p. 298	Elkins Coal & Coke Co. No. 1 (Richard)	714
75	Bull. 2 p. 298	Connellsville Basin Coke Co	716
76	650-H	Terence Stewart	716
77	655-H	Baldwin Weaver	717
78	656-H	O. C. Johnson	717
79	629-H	Daniel Morris	717
80	585-H	U. G. Jennings	718
81	576-H	Edith J. Harvey	718
82	658-H	Emory Jones	338
83	603-H	W. A. C. Carrothers	343
84	713-H	Winona Coal & Coke Co. No. 1	721
85	571-H	C. N. Mason	341
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92	610-H	Jacob Rogers	355
93	627-H	Jacob Rogers	356
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CHAPTER XIII.

CLAY, ROAD MATERIAL, SAND, BUILDING STONE, IRON ORE, WATER POWER RESOURCES AND FORESTS.

CLAY.

An exhaustive discussion of the clay industry of the State is given in Vol. III. of the State Geological Survey Reports by G. P. Grimsley, to which reference is made for a full account of the origin, physical and chemical properties, and the uses of clay.

Present Development.

Potteries.

The **Willetts Company** at Fairmont and the **Homewood Pottery Company** at Mannington are the only potteries located in the territory of this report. The clay used in both plants comes from other States and from Europe. Both plants have been described in Chapter I.

Brick Plants.

The Morgantown Brick Company.—This company, which is located near the northern limit of the city of Morgantown, is mentioned briefly in Chapter I and is described in detail on page 234 of Vol. III. of the State Survey Reports. The product consists of building and paving brick. The material used is quarried from the Pittsburgh Red Shale of the Conemaugh Series, of which the supply is sufficient for many years. A section made at the quarry in 1911 shows the following succession in descending order:

		Thickness. Feet.	Total. Feet.
1.	Shale, red and variegated	30	30
2.	Shale, blue, soft	20	50
3.	Limestone, silicious	2	52
4.	Shale, hard, blue	15	67
5.	Limestone, hard, to R. R. grade	4	71
6.	Concealed to river	20	91

For building brick everything is used from Nos. 1, 3 and 4. For paving brick Nos. 3 and 4 are used. The brick burns to a dark red color. A mechanical test of the paving brick of this company was made by Messrs. Crawford, Bromley and Gaskins at the Mechanical Laboratory of the West Virginia University in 1911 as follows:

Kind of Brick.	Transverse strength, lbs. per sq. inch.	Crushing Strength, lbs. per sq. inch.	Rattler Test, per cent of loss after 1800 revs.	Absorption. Per cent.
Repressed	1842	6497	44.3	....
Wire cut	1895	7840	....	....
Grooved Paving	1917	6332	33.7	2.25

The results show that the brick is excellent for paving purposes.

The same company formerly operated a plant on the west side of the Monongahela river here when building brick was made from Monongahela river clay. A large portion of the property of the company was recently condemned for railroad purposes and the west side plant is not now in operation.

The Empire Brick Company.—This plant is located on the B. & O. R. R. at Star City and its output consists of building brick. There are 4 rectangular, gas-burning kilns. The plant is not in operation. A section made at the shale quarry shows the following:

		Feet.
1.	Concealed	
2.	Shale, black, Little Clarksburg coal horizon	3
3.	Limestone, dark gray, slightly ferriferous and containing fresh water fossils, Clarksburg	6
4.	Shale, red and variegated, to bottom of pit, Clarksburg	25

Hutchinson and Barnes Brick Company.—This plant which has its office at Fairmont and works near the northern limits of the same city has been making brick for nearly forty

years, but has operated under the present management since 1900. The product consists of building brick, with a daily capacity of 30,000 and output of 18,000. The equipment includes a Hercules soft mud machine, a tunnel drier and four rectangular up-draft kilns using natural gas fuel. The bricks burn red, and 9 men are employed.

The raw material is quarried from an extensive deposit of river clay of Quaternary age. A section in descending order shows the following:

		Feet.	Inches.
1.	Sand, limy	4	0
2.	Clay, bluish gray	12	0
3.	Clay, white, very hard	0	1
4.	Clay, bluish gray, to bottom	8	0

A sample collected for analysis by Reger from Nos. 1 to 4 inclusive, shows the following results according to Messrs. Hite and Krak:

	Per cent.
Silica (SiO_2)	63.94
Ferric Iron (Fe_2O_3)	6.32
Alumina (Al_2O_3)	13.53
Lime (CaO)	0.36
Magnesia (MgO)	0.95
Sodium (Na_2O)	0.62
Potassium (K_2O)	1.91
Titanium (TiO_2)	0.35
Phosphoric Acid (P_2O_5)	0.22
Moisture	1.13
Loss on ignition	5.72
Total	100.05

According to T. J. Mason, Superintendent, the best results are obtained by mixing the different strata, although No. 3 is often rejected, owing to its hardness.

United States Sewer Pipe Company.—This company, having its main office in the Frick Building, Pittsburgh, Pa., operates a brick plant at Annabelle, Marion county. The plant, which was established in 1910, makes building brick. There is an automatic wire-cutting machine of 50,000 capacity, two 9-foot dry pans and four up-draft rectangular kilns of 20,000 capacity each, coal being used for fuel. According to James G. Renehan, Superintendent, the plant employs 45 men.

The raw material is quarried from the **Annabelle shale** of the Monongahela Series. A section made in descending order at the shale quarry shows the following, according to Reger:

		Thickness. Feet.	Total. Feet.
1.	Clay soil	4	4
2.	Shale, gray	4	8
3.	Slate, black, 0' 3"	0	8
4.	Shale, greenish brown	12	20
5.	Sandstone, massive, Uniontown	15	35
6.	Shale, gray, very silicious and hard	8	43
7.	Sandstone, massive	4	47
8.	Shale, gray and hard to bed of quarry	6	53
9.	Shale	5	58
10.	Coal, Uniontown	1	59
11.	Shale, silicious, to run	10	69

The bricks are made from Nos 1, 2, 4, 6 and 8 of section and burn to a pale red color. A sample collected from these numbers gives the following analysis according to Messrs Hite and Krak:

	Per cent.
Silica ($Si\ 0_2$)	54.83
Ferric Iron ($Fe_2 0_3$)	7.43
Alumina ($Al_2 0_3$)	20.45
Lime ($Ca\ 0$)	1.78
Magnesia ($Mg\ 0$)	1.55
Sodium ($Na_2 0$)	0.66
Potassium ($K_2 0$)	3.35
Titanium ($Ti\ 0_2$)	0.29
Phosphoric Acid ($P_2 0_5$)	0.59
Moisture	1.28
Loss on ignition	8.34
Total	100.55

The analysis shows that the material is well adapted for building and paving brick.

Colfax Brick Company.—This plant, which is located at Colfax, Marion county, on the main line of the B. & O. Railroad, makes building brick. It was described briefly by G. P. Grimsley in Vol. III. of the Survey Reports, page 274. According to J. L. Johnson, Manager, the company now employs 20 men and makes about 16,000 brick daily. A section made by Reger at the quarry shows the following:

		Feet.
1.	Sandy clay	12
2.	Sand, gray, with river boulders	4
3.	Shale, variegated, Thornton	25
4.	Coal, Upper Freeport	3

The brick is made by mixing the river clay, No. 1 of section, with the Thornton shale and burns red. According to Mr. Johnson, the Thornton shale makes a fair grade of brick

when used alone. A sample collected from No. 3 of section shows the following analysis according to Messrs. Hite and Krak:

	Per cent.
Silica (SiO_2)	61.56
Ferric Iron (Fe_2O_3)	7.14
Alumina (Al_2O_3)	19.69
Lime (Ca O)	0.61
Magnesia (Mg O)	1.42
Sodium (Na_2O)	0.54
Potassium (K_2O)	3.19
Titanium (TiO_2)	0.34
Phosphoric Acid (P_2O_5)	0.34
Moisture	0.31
Loss on ignition	5.10
Total	100.24

A test of brick from this plant, made by G. P. Grimsley under date of Jan. 12, 1906, shows the following results:

Rattler Test—Twelve square-cornered bricks used at each test; first weight, 65½ lbs.

Weight at end of 600 revolutions, 57¾ lbs.; loss, 11.83 per cent.
Weight at end of 1200 revolutions, 55½ lbs.; loss 15.27 per cent.
Weight at end of 1800 revolutions, 53 lbs.; loss, 19.09 per cent.

Crushing strength, 10,380 lbs. per sq. in.; transverse strength, 1870 lbs. per sq. in.; absorption, 5.8 per cent.

The test shows that the brick is well adapted for building purposes.

Hammond Fire Brick Company.—This plant, which is located at Hammond, Marion county, on the main line of the B. & O. Railroad, has been fully described by G. P. Grimsley in Vol. III., pages 220-222. Detailed studies in connection with the present report, however, show conclusively that the fire clay horizon referred to by Dr. Grimsley as the Lower Kittanning, belongs undoubtedly in the Pottsville series of rocks just above the Upper Mercer coal. Its position in the measures under the name of the Hammond Fire Clay may be seen by reference to the geologic section for Powell in Chapter IV.

Thornton Fire Brick Company.—This plant, which is located at Thornton, Taylor county, on the B. & O. Railroad, was described by G. P. Grimsley in Vol. III., pages 223-224. According to G. L. Rogers and J. S. McCann, ceramic engineers now in charge of the plant, the output consists of pav-

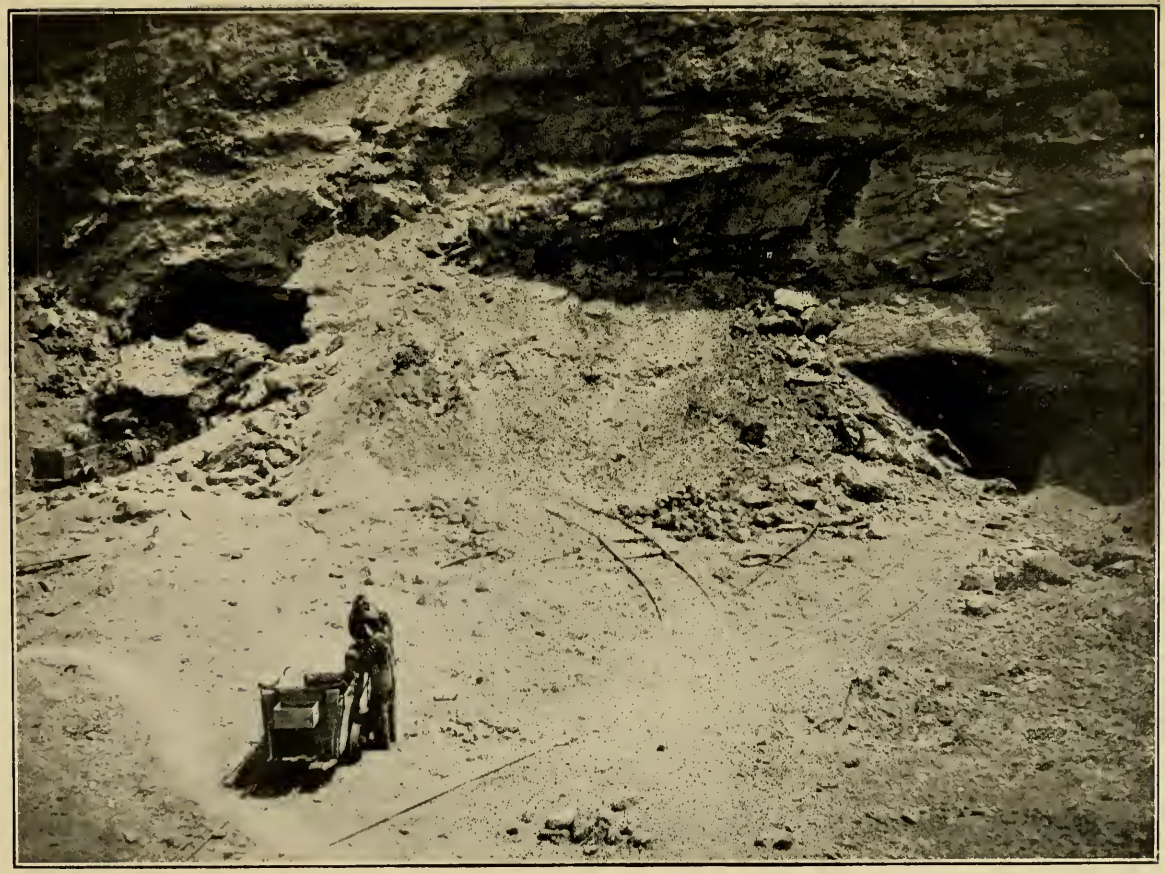

PLATE XXXII.—Combination quarry and mine in the Thornton fire clay, Thornton, Brick Company. Thornton, Taylor County.

ing block, paving brick, fire brick, tunnel brick and ground fire clay. Owing to lack of kiln capacity very little fire brick is made. The daily capacity is 60,000 and 50 men are employed.

A section made at the clay mine by Reger shows the following:

			Feet.
1.	Sandstone, massive, Mahoning		22
2.	Fire clay shale, brown..... 16'	Thornton.....	52
3.	Fire clay shale, gray, with flinty deposits..... 36		
4.	Coal, Upper Freeport		0.3
5.	Fire clay, gray, Bolivar		2.7
6.	Concealed		12
7.	Shale, gray, silicious and micaceous		25
8.	Limestone, silicious, Upper Freeport		3
9.	Shale, gray, with limestone nuggets		10

Nos. 2 and 3 of section are used for brick, being usually mined together and mixed half-in-half. Nos. 7 and 9 have also been mined extensively, but have too much lime for convenient operation. The mixture burns to a buff color. Samples collected from Nos. 2 and 3 of section show the following analyses according to Messrs. Hite and Krak:

	Brown Shale, No. 2 Per cent.	Fire Clay, No. 3 Per cent.
Silica ($Si\ 0_2$)	65.01	64.19
Ferric Iron ($Fe_2 0_3$)	5.38	4.32
Alumina ($Al_2 0_3$)	17.96	20.66
Lime ($Ca\ 0$)	0.66	0.55
Magnesia ($Mg\ 0$)	1.00	0.53
Sodium ($Na_2 0$)	0.19	0.64
Potassium ($K_2 0$)	3.00	2.82
Titanium ($Ti\ 0_2$)	0.63	0.52
Phosphoric Acid ($P_2 0_5$)	0.23	0.22
Moisture	0.96	1.05
Loss on ignition	5.19	5.08
Total	100.21	100.58

The deposits of flint clay contained in No. 3 of section, as analyzed separately in Vol. III., page 224, show a much higher refractory character than the analyses here given. This feature makes necessary a careful selection of clay for the various uses to which it is put.

Mr. D. R. Potter, general manager of the Thornton Company, has furnished the Survey the following tests of Thornton brick:

Report of Tests of Paving Block Made for Thornton Fire Brick Company, June 2, 1911, by Pittsburgh Testing Laboratory.

Lab. No.	Mark.	Dimensions. Inches.	Area.	Load.	Crushing Strength per sq. in.
33137	B.7	3.80x3.00x3.80	11.40	160,100 lbs.	14,030 lbs.
33138	8	3.85x3.00x3.80	11.55	118,300 lbs.	10,240 lbs.
33139	N.B	2.90x2.86x3.76	11.15	134,000 lbs.	12,020 lbs.

Report of Tests of Tunnel Block Made for the Thornton Fire Brick Company, July 5, 1911, by Pittsburgh Testing Laboratory.

Lab. No.	Mark.	Dimensions. Inches.	Area.	Load.	Crushing Strength per sq. in.
33320	No. 1	3.50x3.02x3.80	10.57	85,350 lbs.	8.075 lbs.
33321	No. 2	3.45x3.00x3.80	10.35	95,450 lbs	9,223 lbs.
33322	No. 3	3.50x3.04x3.72	10.64	96,000 lbs.	9.022 lbs.
33323	No. 4	3.50x3.10x3.70	10.85	82,000 lbs.	7,558 lbs.
33324	No. 5	3.50x3.00x3.84	10.50	76,000 lbs.	7,238 lbs.
33325	No. 6	3.12x3.08x3.90	9.61	57,100 lbs.	5,942 lbs.

One-half block crushed on edge.

Collins P. Bliss, Director of the Testing Laboratory of the New York University, reports the following test of Thornton brick:

"The loss on the abrasion test was only 14.32; the transverse test showed a strength of 2370 lbs. per sq. in.; the specific gravity was 2.34, and the absorption, 2.22 per cent after 48 hours' drying and 48 hours' soaking of specimens that had already passed through the rattler."

Prof. Edward Orton, Jr., of the Ohio State University, reported the following rattler test of Thornton brick made according to the specifications of the National Brick Manufacturer's Association, under date of March 18, 1907:

	First Charge.	Second Charge.
Initial weight of 10 bricks.....	104.0 lbs.	101.5 lbs.
Weight of same after 1800 revolutions	87.4 lbs.	84.5 lbs.
Loss by rattling	16.6 lbs.	17.0 lbs.
Percentage loss	15.96 lbs.	16.75 lbs.

Average percentage loss for both charges, 16.35. No bricks broken.

Available Clay

The transported clays of the territory of this report may be classed under two heads; viz., the recent or river clays that are to be found in great abundance along the larger streams, and the Pleistocene clays that were deposited during the Glacial Epoch along the Monongahela Valley and that, so far as observed, do not appear at a level higher than 1060′ above tide. In Monongalia county there are large deposits of river clay along Dunkard creek that probably contain sufficient plastic substance to make them available for building brick. In the J. O. and E. Price oil test well, 1½ miles east of Pentress, 58 feet of quicksand was reported, which probably represents the maximum thickness of river clay in the Dunkard valley. River deposits usually vary greatly in their character and money may be safely spent in the erection of a brick plant only after careful investigation of the clay.

On the Monongahela river, between Morgantown and the Pennsylvania line there are large deposits of river clay that offer favorable opportunity for brick manufacture. These deposits have been worked successfully at Morgantown.

On the Tygart Valley river in Taylor county, near Fetterman, there are deposits of clay that were formerly used for brick, that are still available.

The Pleistocene deposits of the Monongahela Valley vary in thickness from 50 to 100 feet. They occur in great abundance at Morgantown and at the junction of the West Fork and Tygart Valley rivers at Fairmont. They are usually too sandy to be classed as clay deposits. One mile northeast of Star City the following section, made with hand-level by Reger and arranged in descending order, shows the succession of the Pleistocene deposits:

	Thickness. Feet.	Total. Feet.
1. Sand, loamy	24	24
2. Sand, moulder's	6	30
3. Sand, good	8	38
4. White clay, good	26	64
5. River sand	18	82

(Elevation of base, 902′ L-A.T.)

Two samples were collected for analysis from No. 4 of

section, one being taken from the upper portion while the other was from the lower 3 feet, which Messrs. Hite and Krak report as follows:

	Upper portion of No. 4. Per cent.	Lower 3 feet of No. 4. Per cent.
Silica (SiO_2)	62.96	66.50
Ferric Iron (Fe_2O_3)	3.43	2.59
Alumina (Al_2O_3)	21.11	19.47
Lime (Ca 0)	0.12	0.38
Magnesia (Mg 0)	0.79	0.62
Sodium (Na_2O)	0.82	0.29
Potassium (K_2O)	3.12	2.70
Titanium ($Ti\ O_2$)	0.44	0.50
Phosphoric Acid (P_2O_5)	0.12	0.14
Moisture	1.07	1.12
Loss on ignition	6.13	5.42
Total	100.11	99.73

Mr. R. B. Reid operates an extensive stripping at this point mostly for sand, the plant being discussed under that head on a subsequent page. The analyses given above indicate that both samples would make a good grade of buff building brick, and also could be manufactured into drain and sewerage tile.

Shale.

There is an abundance of excellent shale for brick making in every district of the three counties. The Washington fire clay shale, which occurs just below the Washington coal, the crop of which is shown on Map II., would provide material for brick wherever it is found. The Annabelle shale of the Monongahela Series and the Clarksburg red shale and Pittsburgh red shale of the Conemaugh series are widely distributed and are uniformly good both for building and paving brick. The two latter formations would be suitable for roofing tile. The Mauch Chunk red shale, often 300 feet thick at its crop along Cheat river and Decker's creek in Monongalia county, offers an unlimited amount of material suitable for brick. Dr. Heinrich Ries[1] gives the following analysis of Mauch Chunk shale from Decker's creek:

1. Clays, Their Occurrence Properties and Uses, 1908, page 502.

	Per cent.
Silica ($Si\ 0_2$)	56.30
Alumina ($Al_2 0_3$)	19.07
Ferric Oxide ($Fe_2 0_3$)	9.58
Lime ($Ca\ 0$)	0.69
Magnesium ($Mg\ 0$)	2.01
Titanic Oxide ($Ti\ 0_2$)	0.71
Loss on ignition	8.01
Total	96.37

The large percentage of ferric oxide would insure the rich red color so often desired for building brick.

Fire Clay.

In the territory of this report no fire clays of importance are found except in the lower portion of the Conemaugh and the Allegheny and Pottsville Series. Since these rocks do not crop west of the Monongahela river it will be useless to search for fire clay in that region. East of the Monongahela river, however, there is an abundance of outcropping fire clay of excellent quality. The principal fire clay horizons are the Thornton, Bolivar, Upper Kittanning, Hardman, Lower Kittanning, Mt. Savage and Hammond. They have all been described and analyses published in previous chapters. Since the samples for analyses were collected at the points of best development those localities are here referred to as the most likely prospects for their utilization.

ROAD MATERIAL.

Limestone

The principal limestones suitable for road-making in the territory of this report are contained in the Monongahela, Conemaugh, Allegheny and Greenbrier Series of rocks. Reference to Map II. will show where these series crop. While there are limestone members in the Dunkard Series they are too thin to be quarried economically for road material. The several limestones of the three series that contain them in

abundance have been described in previous chapters. Reference is here made to the Uniontown, Benwood, Sewickley, Upper and Lower Pittsburgh, Clarksburg, Elk Lick, Upper and Lower Freeport and Greenbrier limestones as the ones best suited for macadam. Their chemical composition is not important, but their ability to withstand weathering and abrasion and the thickness of the ledges and convenience of quarrying are the test of their worth.

River and Creek Gravel

There is an abundant supply of gravel in nearly all the stream beds that is available for road material. This gravel is, for the most part, composed of the more durable portion of the sandstone cliffs through which the streams have cut their way and for this reason is far superior in wearing qualities to the broken sandstone that is sometimes applied to roads. It requires only the labor needed to place it upon the roads and, when placed, is self-draining.

Brick For Road Pavement

Reference has previously been made in this chapter to the great amount of material available for the manufacture of paving brick. While brick paving heretofore has been for the most part confined to the cities, there is no reason why it should not be used for country roads where their improvement is desired. In nearly every magisterial district in the territory of this report there is plenty of material for brick as well as coal or gas with which to burn it. The use of brick for road paving would obviate the necessity of paying heavy freight charges on material shipped from distant points and would foster local brick-making and mining industries in a way that would be of great benefit to the communities where they would be located.

PLATE XXXIII.—Quaternary sand deposit at the quarry of the New England Sand Company at Kingmont, Marion County

SAND BANKS.

Present Development

R. B. Reid Bank.—This bank, which is located one mile northeast of Star City, has already been mentioned under the discussion of "Clay," where a section was given, showing the character of the deposits. The plant employs 3 men, but has a capacity of three carloads of sand daily when running full. Sand is furnished for building and foundry purposes, being used extensively in Morgantown. The sand is clean enough for ordinary use as it comes from the bank, but it is often run through a washer before being shipped. The sand belongs to the Pleistocene deposits previously mentioned, the amount available being enormous.

New England Sand Company.—This plant has its office at New England and works at Kingmont in Marion county. According to C. C. Durrett, Superintendent, the company was established in 1907 and supplies sand for the building trade. The capacity is 4 carloads daily, the average shipment being 2 carloads, 6 men being employed. The sand is dug from the hill east of Kingmont and conveyed through a sluice to the railroad, sufficient water being added at the mine to cause the sand to flow through the sluice. The sand is washed before shipment.

According to Reger, the deposit belongs in the Pleistocene or terrace formations which cover the low hills east of Kingmont with an elevation of 1045 feet above sea at the top and have a maximum observed thickness of 80 feet. The mine is in the top portion, the excavation being 25 feet deep. The sand contains no clay but has an abundance of river boulders or concretions that must be discarded.

Lilley Sand Bank.—This plant, which is located between Benton Ferry and Kingmont, was established in 1899 by George M. Lilley and furnishes sand for building purposes. The capacity is 2 carloads daily, 4 men being employed. The sand is conveyed through a gravity sluice to the railroad and is washed before shipment. Arch Lilley is authority for the foregoing data.

According to Reger, the sand is quarried from the same terrace deposits noted at the New England plant, the following section being made in descending order at the quarry:

		Thickness. Feet.	Total. Feet.
1.	Soil	2	2
2.	Sand, yellow	20	22
3.	Iron ore, lenticular	0.2	22.2
4.	Clay, to bottom	1	23.2

Deckers Creek Stone and Sand Company.—This plant, which is located at Sturgisson, Monongalia county, on the Morgantown & Kingwood railroad, operates a large quarry for glass sand and sand for building purposes. The plant was fully described by G. P. Grimsley in Vol. IV., pages 388 and 515, to which reference is here made. In that report the horizon of the quarry was mentioned as the Homewood sandstone. Detailed studies published in Chapter IX. of this report, show conclusively that the quarry is in the Upper Connoquenessing sandstone which is the next sandstone below the Homewood member of the Pottsville Series. According to J L. Mayfield, foreman, the present capacity of the plant is 150 tons daily.

Columbia Tile Company.—The Columbia Tile Company at its Grafton plant is making extensive use of glass sand in the manufacture of wall tile. The following valuable series of tests was made for the use of the Survey from tile made at this plant:

ABSTRACT OF REPORT OF COMPARATIVE TESTS OF GLASS AND CLAY TILE, for strength, adhesion and absorption with mortars and different kinds of cement, lime and plaster and different heat treatments by H. M. Leps, Consulting Mechanical Engineer, Grafton, W. Va., and John B. Grumbein, Assistant Professor of Mechanical Engineering, West Virginia University, under the supervision of C. R. Jones, Dean of the College of Engineering, of the West Virginia University. The tests were made in the University Laboratories.

Material Tested.—1. 6" x 3" Opal Glass Tile, with undercut corrugations for holding tile to the setting mortar, manufactured by the Columbia Tile Company of Grafton, W. Va.

2. 6" x 3" Clay Tile, manufactured by four different companies, designated here as "A," "B," "C," and "D," made with varying proportions and forms of undercuts as indicated in table I.

3. The mortars used were of different proportions (weighed dry) of cement, lime, sand, and "Patent" wall plaster as indicated in tables by number. Two brands of cement were used—Atlas white cement, designated as "A," and Alpha Portland Cement, designated as

"M." The average tensile strength of the Alpha cement for specimens, 40 days old, was for neat cement 340 lbs. per sq. in. and for equal parts of sand and cement, 267 lbs. per sq. in. The sand used in all mixtures was white silica or glass sand, sharp, clean and dry and was passed through a No. 20 mesh sieve. The lime used was white building lime from near Martinsburg, W. Va. The wall plaster was supplied by the Fairmont Wall Plaster Co.

Description of Tests.—Specimens of the different tiles were taken, untreated in any way, for the transverse tests.

For the tests of strength of bond to wall, the glass and clay tiles were set on blocks of concrete 1½" thick, 5" x 5" on one side, tapered to 5 x 6 on opposite side so that blocks could be held in a shackle. Two 6" x 3" tile were set on the 5" x 5" face of each block, giving the tile ½" projection all round the block, so that by placing the bottom of block in shackle and resting the projection of tiles on a suitable support, the tile could be drawn from the setting in tension machine.

Identical mixtures of mortar were used in setting specimens of each tile and identification numbers cut in blocks as made. Treatment after setting was the same throughout.

The blocks on which the tiles were set were made of one part Portland cement to two parts sand with just sufficient water to enable the mixture to be moulded in a hinged form by ramming up and troweling, the surface becoming wet enough to smooth under the trowel, level with the top of form. The surface was immediately roughened by cross cutting with the edge of trowel, locating frame pinned in place and tile set at once. To set tile it was buttered smoothly on the back with setting mortar, placed on a wet roughened surface of block and settled into place with trowel handle used as a rammer. Clay tile was soaked in clear water over night before setting. Where lime was used it was slacked into a paste and added to the cement paste in proper proportion by weight.

Treatment.—After setting for twelve hours, blocks were moved to a platform in a damp cellar and sprinkled copiously with water and thereafter sprinkled until thoroughly wet, twice a day for twenty-one days, at which time the specimens subject to heat treatment were placed in a dry freezing can and subjected to a temperature of 18° for twenty-four hours, and then removed from the freezing can and placed in an ice chest without ice and allowed to come slowly to atmospheric temperature. These test blocks were then placed in glass tempering lehrs regulated to a temperature of 500° F. at which they remianed for twelve hours. Temperature was then raised within thirty minutes to 1000° F. (approximate) remaining so for three hours. Fire was then turned off and blocks allowed to cool slowly to atmospheric temperature, and their condition noted. Table IV.

Results of Tests.—The most important deduction is that the strength of the bond between tile and wall is dependent on the strength of the setting mortar and the proportion of "undercut" or mechanical holding surface on the back of the tile. The strength of the setting mortars increased with the percentage of cement in the mixture. There was no chemical bond indicated between clay tile and setting mortar. Other results appear in the tables.

Table I. Dimensions and weight.

Kind.	Designation.	Dimensions. Inches.	Average weight. Ounces.	Undercut or grips. Per cent of area.
Clay	A	6x3x⅜"	7.1	3.3
"	B	6x3x⅜"	7.1	2.5
"	C	6x3x½"	7.3	4.7
"	D	6x3x⅜"	7.1	10
Glass	Glass	6x3x⅜"	8	20.8

Table I(A). Setting Mortars.
A—Atlas, and M—Alpha.

Mixture Number.	Kind of Cement.	Cement Parts.	Lime Parts.	Sand Parts.	Patent Plaster Parts.	
1	A and M	1	0	2	0	Constituents of
2	" " "	1	0	3	0	Wall plaster
3	" " "	1	0	4	0	not given.
4	" " "	1	1	3	0	
5	" " "	1	2	4	0	
6	A	1	1	0	0	
7	A	1	0	0	0	
8	A	1	0	1	1	
9	P	0	0	0	1	

Table II. Transverse Tests, Tile Laid on Wood Supports 5½" Between Centers, Load at Middle.

Kind and Letter.	Thickness. Inches.	Number of tile tested.	Average breaking load, lbs.	Difference.	Per cent excess glass over clay.
Glass	⅜	18	268	...	...
Clay A	⅜	7	47	221	470
" B	⅜	6	127	141	111
" C	½	5	189	79	41
" D	⅜	5	81	187	230

Table III. Data Sheet: Tension, Material, Test Blocks, Set With Glass and Clay Tile.
Date Set: March 25th, 1913; Date Tested: May 1st, 1913; Age, 37 Days.

Mixture No.	Cement Kind	Tile Kind	Number blocks tested	Average breaking load		Character of break			Remarks.
				Total lbs.	Per sq. in. lbs.	Bond	Mortar	Tile	
1	A	Glass	8	320	12.8	0		4	
2	A	"	1	180	7.2	0	1	0	
3	A	"	4	173	6.9	0	4	0	Area of
4	A	"	2	268	10.7	0	2	1	tile surface
5	A	"	3	263	10.5	0	3	0	in contact
6	A	"	6	302	12	0	6	2	with block
7	A	"	4	478	19	0	0	8	25 sq. in.
8	A	"	2	213	8.5	0	2	0	in all
9	P	"	7	275	11	0	7	4	cases.

Mixture No.	Cement Kind	Tile Kind	Number blocks tested	Average breaking load		Character of break			Remarks.
				Total lbs.	Per sq in. lbs.	Bond	Mortar	Tile	
1	M	"	3	422	17	0	3	0	
2	M	"	4	180	7.2	0	4	0	
3	M	"	2	192	7.7	0	2	0	
4	M	"	4	196	7.8	0	4	0	
5	M	"	4	248	9.8	0	4	2	
1	A	Clay	3	208	8.3	3	3	2	
2	A	"	4	93.3	3.7	4	4	0	
3	A	"	3	98	3.9	3	3	0	
4	A	"	4	179	7.0	4	4	0	
5	A	"	5	119	4.7	5	3	0	
6	A	"	7	204	8	5	5	8	
7	A	"	4	344	13.7	2	0	7	
1	M	Clay	2	330	13.2	2	2	2	
2	M	"	4	136	5.4	4	2	1	
3	M	"	3	83	3.3	3	2	0	
4	M	"	3	113	4.5	3	3	0	
5	M	"	3	87	3.4	3	2	0	

Values in column (7) represent number of blocks from which tile separated clean.

Column (8) number of blocks on which setting mortar broke.

Column (9) number of single tile broken.

Table III(A). Adhesion.

Mixture No.	Cement	Breaking load per sq. in		Difference	Per cent excess glass over clay.	Remarks.
		Glass lbs.	Clay lbs.			
1	A	12.8	8.3	4.5	55	
2	A	7.2	3.7	3.5	94	
3	A	6.9	3.9	3.0	76	
4	A	10.7	7	3.7	53	Average 71 per cent.
5	A	10.5	4.7	5.8	123	
6	A	12	8	4	50	
7	A	19	13.7	5.3	38	
1	M	18	13.2	3.8	28	
2	M	7.2	5.4	1.8	33	
3	M	7.7	3.3	4.4	133	Average 91 per cent.
4	M	7.8	4.5	3.3	73	
5	M	9.8	3.4	6.4	191	

Table III(B). Adhesion After Temperature Treatment.

Mixture No.	Cement	Breaking load per sq. in.		Difference.	Per cent. excess.	Remarks.
		Glass lbs.	Clay lbs.			
1	A	2	2.4			
2	A	2	3			
3	A	...	...			
4	A	...	...			
5	A	2.7	...			All specimens in this test were frozen at 18° F. heated to 500° F. then to 1000° F.
6	A	1.4	...	Results too irregular for comparison.		
7	A	4.8	...			
1	M	1.8	...			
2	M	...	0.2			
3	M	...	0.2			
4	M	1.2	...			

Table IV. Temperature.

Twenty-three test blocks set with glass tile and 13 blocks set with clay tile subjected to freezing at 18° F. for 24 hours and afterward heated up to 1000° F. (Approximate).

GLASS.				CLAY.			
No. of 6x3 tile.	Setting mortar broken No. Blocks.	Separated without breaking tile or mortar. No. tile	Crazed. No. tile.	No. of 6x3 tile.	Setting mortar broken No. Blocks.	Separated without breaking tile or mortar. No. tile	Crazed.
46	6	2	0	26	0	11	14
Per ct.	13.0 p. ct.	4.3 p. ct.				42 p. ct.	54 p. ct.

Table V. Absorption.

Twelve glass and 12 clay tile soaked in water for 12 hours, after drying in a temperature of 350° for six hours.

Kind Tile.	Average Weight dry.	Average Weight net.	Water Absorbed.	Per cent of dry weight.
	Grains.	Grains.	Grains.	
Clay	3714	4125	411	11
Glass	4480	4480	000	00

Available Sand

The Pleistocene, or terrace deposits, of the Monongahela valley, already extensively developed, offer a large amount of sand for building purposes. Since the sand is loose, requiring no blasting, and the deposits are all convenient to railway transportation, it can be handled at a minimum cost. It is doubtful whether this sand should be used for concrete work without washing where strength of material is important, as the presence of a large amount of organic matter, such as the sand contains, would weaken the structure.

The only regions in the territory of this report where glass sand may be found are those in which the Pottsville series of rocks are above drainage, as the sandstones of all the other series are not chemically suitable. In the valley of Deckers creek, Monongalia county, these rocks are above drainage from Dellslow to Cascade and offer many suitable locations for quarries. In the Cheat river canyon the Potts-

ville series lies above drainage from Mont Chateau to the Preston county line, but lack of transportation prevents any present development. The Homewood sandstone of the Pottsville series crops in southeastern Clinton district, but here, also, transportation is lacking. In Marion county the Homewood and Connoquenessing sandstones both crop along the Tygart Valley river at Valley Falls, where quarries could easily be developed.

BUILDING STONE.

Quarries

In Vol. IV of the State Geological Survey Reports, G. P. Grimsley has described the following sandstone quarries located in the Monongalia-Marion-Taylor area:

Quarry.	Sandstone Horizon.	Location.	Page of Vol. IV.
J. D. Charlton	Mannington	Mannington	440
A. R. Wilcox	Waynesburg	Downs	449
Georges Creek C. & C. Co.	Waynesburg	Underwood	449
C. B. Conoway	Waynesburg	Barrackville	450
Georges Creek C. & C. Co.	Gilboy	Underwood	452
J. F. Watson	Sewickley (Arnoldsburg	Fairmont	459
George Lilley	Pittsburgh	Fairmont	463
J. F. Watson	Upper Pittsburgh	Fairmont	463
W. B. Ice & Co.	Upper Pittsburgh	Fairmont	464
Wm. Cox	(Lower) Connellsville	Morgantown	471
Zevely & Casto	Morgantown	Morgantown	477
Wm. Gaston	Morgantown	Morgantown	478
Ramsey & Stark	Buffalo	Fetterman	485
Ramsey & Stark	Buffalo	Fetterman	486
W. A. Willhide	Buffalo	Grafton	486
Chas. Stozenfels	Buffalo	Grafton	487
John M. Keane	Buffalo	Grafton	489
—— Christian	Buffalo	Morgantown	490
L. V. Keck	Buffalo	Morgantown	491
Sims & Co.	Mahoning (Upper Freeport)	Yates	495
D. H. Going	Homewood	Dellslow	514
Deckers Creek Sand Co	Homewood (Upper Connoquenessing)	Sturgisson	515

In a few cases where the detailed studies of the present report show a different identification, the latter is shown in parentheses.

Additional quarries, observed in the preparation of the present report, have been described under their proper geological horizons in the chapters on Stratigraphy.

Available Stone

Reference to the quarries noted above will show that a wide use has already been made of various sandstones of this area. Since the presence of good sandstone for building purposes is general, the statement is warranted that the sandstone industry deserves a much greater development. The following table will show the various sandstone horizons that are available for quarrying. They have been described already under the chapters devoted to Stratigraphy and their points of maximum development given. Those given in black font type have already been quarried within this area:

Dunkard Series:
- Proctor Sandstones.
- **St. Cloud Sandstone.**
- Gilmore Sandstone.
- Taylor Sandstone.
- **Nineveh Sandstone.**
- Burton Sandstone.
- **Fish Creek Sandstone.**
- **Rush Run Sandstone.**
- Jollytown Sandstone.
- **Hundred Sandstone.**
- Upper Marietta Sandstone.
- Lower Marietta Sandstone.
- **Mannington Sandstone.**
- **Waynesburg Sandstone.**

Monongahela Series:
- **Gilboy Sandstone.**
- **Arnoldsburg Sandstone.**
- Upper Sewickley Sandstone.
- Lower Sewickley Sandstone.
- **Upper Pittsburgh Sandstone.**

Conemaugh Series:
- **Lower Pittsburgh Sandstone.**
- **Connellsville Sandstone.**
- **Lower Connellsville Sandstone.**
- **Morgantown Sandstone.**
- **Grafton Sandstone.**
- Saltsburg Sandstone.
- **Buffalo Sandstone.**
- **Mahoning Sandstone.**

Allegheny Series:
- **Upper Freeport Sandstone.**
- Lower Freeport Sandstone.

Pottsville Series:
- **Homewood Sandstone.**
- **Upper Connoquenessing Sandstone.**
- Lower Connoquenessing Sandstone.

Reference is here made to Chapter XXV of Vol. IV of the State Geological Survey Reports, by G. P. Grimsley, for an exhaustive discussion of the "Examination and Testing of Building Stone."

IRON ORE.

Old Furnaces

Monongalia county was the scene of an extensive iron making industry from 1800 to 1870. Five furnaces were operated along Cheat river near Ice's Ferry, one at Clinton Furnace, on Booths creek, and one at Rock Forge on Deckers creek. In Marion county there was a furnace on Piney run of Pricketts creek, Winfield district. In Taylor county there was a furnace on the Tygart Valley river at the mouth of Lost run and another on Threefork creek at Irontown. With the exception of the Irontown furnace, on which no information is available, these old furnaces were all described by G. P. Grimsley in Chapter V of Vol. IV of the State Geological Survey Reports.

Available Ore

The available iron ores of the territory of this report are to be found in the Conemaugh, Allegheny and Pottsville series of rocks.

Iron Ore of the Conemaugh Series.

Johnstown Iron Ore.—At Lock No. 13 on the Monongahela river, one mile westward from Little Falls, a section published in Chapter VII shows a stratum of iron carbonate ore 6 inches thick and lying 20 feet under the Brush Creek coal. A sample collected here shows the following partial analysis, according to Messrs. Hite and Krak:

	Per cent.
Silica ($Si\ 0_2$)	12.12
Metallic Iron	38.78
Lime (Ca 0)	4.53
Sulphur	1.07
Phosphorus	0.60

According to I. C. White the same iron ore is well exposed in a cut of the Buckhannon & Northern Railroad opposite Scrafford, near Morgantown. On Wickwire run in Fetterman

district, Taylor county, there is an exposure of iron ore at this horizon in the form of nuggets scattered through the Brush Creek shale. In many other locations where this horizon is exposed no iron ore was observed, so that its occurrence at this horizon is uncommon.

Iron Ore of the Allegheny Series.

In eastern Monongalia county, eastern Marion and northeastern Taylor there is a large amount of iron carbonate ore lying just beneath the Upper Freeport coal. In some places it evidently replaces the Upper Freeport limestone, as the two are intimately associated. Nodules of the ore are often found scattered through a gray shale for a distance of thirty feet below the coal. This ore is exposed in the old workings near Rock Forge, Monongalia county. On a branch of Booths creek one mile north of Clinton Furnace, Reger observed 25 feet of ferriferous shales just under the Upper Freeport coal. The same coal is mined in the hills at Clinton Furnace.

In Winfield district, Marion county, on Prickett creek, one-half mile south of Canton, Reger found 1 foot of iron ore fourteen feet below the Upper Freeport coal. A sample collected here gave the following partial analysis according to Messrs. Hite and Krak:

	Per cent.
Silica ($Si\ 0_2$)	14.84
Metallic Iron	38.99
Lime (Ca 0)	4.81
Sulphur	1.31
Phosphorus	0.36

At the old Piney Furnace in Winfield district, Reger observed 51 feet of shales with nodules of limestone and iron carbonate beginning 20 feet under the Upper Freeport coal. At Irontown, Taylor county, he also found an old stripping of iron ore at this horizon just north of Threefork creek, but its thickness was concealed. At Irondale, Preston county, near the Taylor line, this ore was formerly mined extensively for furnace use. The stratum shows 2 feet 9 inches of calcareous iron carbonate lying just below the Upper Freeport limestone.

A sample collected here shows the following partial analysis according to Messrs. Hite and Krak:

	Per cent.
Silica (Si 0_2)	3.60
Metallic Iron	32.88
Lime (Ca 0)	13.83
Sulphur	0.73
Phosphorus	1.99

This ore has been worked at other points along Threefork creek south of Irondale along the Taylor-Preston line, so that it is safe to assume that the hills of this portion of Taylor county contain a large amount of ore.

Below the Lower Kittanning coal the iron ore at the horizon of the Vanport limestone or Buhrstone iron ore was observed at a few localities. One-half mile east of Dellslow, according to Reger, float ore from this formation is exposed in the field near the M. & K. railroad and a short distance above the Homewood sandstone. On the head of Booths creek near the residence of Granville Brown it is exposed in the road where it is from 12 to 18 inches thick and lies 10 feet above the Homewood sandstone. At the Eureka school house at the mouth of Laurel run of Whiteday creek, Marion county, this ore is exposed. Here it has the following section:

		Feet.	
1.	Coal, Lower Kittanning		
2.	Concealed	35	
3.	Iron ore 0′ 10″		
4.	Shale, buff 3 0	4′	10″
5.	Iron ore 1 0		

A sample collected from Nos. 3 and 5 of section shows the following partial analysis, according to Messrs. Hite and Krak:

	Per cent.
Silica (Si 0_2)	18.40
Metallic Iron	56.64
Lime (Ca 0)	Trace.
Sulphur	1.35
Phosphorus	0.45

At all these points this ore has a deep red color, apparently being thoroughly oxidized. Another exposure of this ore was

observed by Reger at Irontown where it was formerly mined for furnace use. Here there is 41 feet of shale with boulders of limestone and iron carbonate ore lying just above the Clarion coal. A sample of ore collected here shows the following partial analysis according to Messrs. Hite and Krak:

	Per cent.
Silica (SiO_2)	13.08
Metallic Iron	37.33
Lime (CaO)	5.43
Sulphur	0.67
Phosphorus	0.96

Iron Ores of the Pottsville Series.

Between the Homewood and Upper Connoquenessing sandstones iron ore is frequently found. There are sometimes two or three horizons of ore varying in composition from calcareous carbonates to rich hematites. These ores are prevalent in the neighborhood northeast of Ices Ferry in Monongalia county where they were extensively worked at the old furnaces. South of Cheat river at Cheat View, the following exposure of ore was observed at an old digging:

		Feet.
1.	Sandstone, flaggy	2
2.	Concealed and coal blossom	2
3.	Fire clay and concealed	9
4.	Iron ore, thickness concealed	0
5.	Concealed to Upper Connoquenessing sandstone	10

A sample collected from the dump shows the following partial analysis according to Messrs. Hite and Krak:

	Per cent.
Silica (SiO_2)	9.67
Metallic Iron	45.73
Lime (CaO)	0.78
Sulphur	1.10
Phosphorus	0.37

At Powell, Marion county, on the Tygart Valley river, there is a ferriferous limestone, 6 inches thick, lying just above the Lower Mercer coal that probably represents one of the ore horizons of the Cheat river canyon. There is another exposure at Barkers Mill on Lost Run, from which an analysis may be

found under the description of the Pottsville Series in Chapter IX.

Below the Upper Connoquenessing sandstone there is another group of iron ores that have been worked on Cheat river. There are several horizons contained in the sandy shales between the Upper Connoquenessing sandstone and the top of the Mauch Chunk series. These ores were observed at several points between Cheat river and the Pennsylvania State line.

An excellent treatise on the iron ores of the Cheat river region is given in the report made by Dr. Wm. B. Rogers[2] for the Pridevale Iron Company in 1854. Since the ore was being mined at the time of his report, it was possible for Dr. Rogers to obtain a much more satisfactory view of the strata than is to be had at the present time. In Vol. IV., Chapter V., of the State Geological Survey Reports, G. P. Grimsley has furnished a large amount of valuable data on the iron ores of the territory of this report. In Vol. IV. will be found extensive quotations from Dr. Rogers' report.

WATER POWER RESOURCES.

It is only within the last three or four years that the great water power resources of West Virginia have attracted the attention they merit and inasmuch as the first great project for utilizing such power in the State is located within the boundaries of the territory of this report, a brief discussion of the same is of special interest to the residents therein.

The gradual exhaustion of our large stores of mineral fuels will hasten the development of our water power to the economic limit. The following interesting statements are taken from a Paper on the Water Power Resources of West Virginia[3] by A. H. Horton, District Engineer, Water Resources Branch U. S. Geological Survey.

"******the minimum amount of energy developed by the streams in West Virginia is about 350,000 horsepower, the assumed maximum is 1,163,000 horsepower. It takes from 11-15 tons per year of high grade steam coal to produce one continuous horsepower in the most efficient steam engines in ordinary use. The amount of coal, based upon the lower of the above figures, necessary to produce the minimum horse-

2. Geology of the Virginias, 1884; pages 679-701.
3. Report of Semi-Centennial Commission of W. Va.; 1913.

power developed by West Virginia streams is therefore 3,850,000 tons per year, to produce the maximum, 12,800,000 tons per year.

"The annual cost of producing power by steam plants varies from about $25.00 to $150.00 per horsepower, depending upon the type of engine and boiler and the capacity of the plant. These figures include interest at 5 per cent., depreciation, repair, oil, waste, labor and fuel, using coal at $2.00 per ton.

"Water power must, of course, compete with steam power, derived, in general, from coal. It will therefore remain undeveloped unless it can be disposed of at less cost, except to certain customers who will pay a higher price for the convenience of obtaining electrical power.

"It costs from about $45.00 to $200.00 per horsepower measured at the turbine shaft to construct water power plants ready to deliver electrical power. This electrical power can be sold for less in the immediate vicinity of the power plant than anywhere else as the cost of transmission is considerable and varies with the distance, voltage, and amount transmitted.

"To prevent a threatened water power monopoly and reduce rates for electricity, the Province of Ontario, Canada, created a Hydro-Electric Power Commission in 1906 with full power to control plants and to buy and sell power. This Commission is now operating 300 miles of 110,000 volt main transmission lines and 180 miles of distributing lines buying current from the Ontario Power Company, a private corporation at Niagara Falls, at $9.00 per horsepower per annum. The rates charged the municipalities to cover cost, vary from $18.00 to $29.50 per horsepower per annum, according to distance. The Commission is supplying at present 30 municipalities. The City of Toronto, located approximately 90 miles from the source of power, purchases 10,000 horsepower from the Commission at the rate of $18.50 per horsepower per annum for 24-hour service, which is very much less than it would cost if produced by steam plants.

"What has been done in Ontario, Canada, can be done in West Virginia or any other State. At present there is very little hydro-electric power developed in this State and the passing of laws to regulate the price of electricity for use as power or for illumination ought not to be a difficult matter. The need of legislation or of a Commission to regulate the charges for electricity is shown by the fact that at Buffalo electricity costs $25.00 per year per horsepower, while at Toronto, which is three times as far from Niagara Falls, the common source of power, the price is 26 per cent. less."

The three following tables by Mr. Horton, taken from the same Paper, give the horsepower available from storage on the Tygart-Monongahela and Cheat rivers:

Table No. 12. Indicated Horsepower Developed by the Tygart-Monongahela River.

Section of River		Length Miles.	Mean Drainage Area....	Minimum Discharge	Assumed Discharge for Maximum Development.	Total Fall. Feet	Minimum Horsepower .	Assumed Maximum Development. Horsepower.	Horsepower (b) Available from Storage for		
From	To								12 mos.	6 mos.	3 mos.
Tygart River			Sq. mi.	Sec.-ft.	Sec.-ft.						
Source	Below Pound Mill Run...	19	a88	7	46	1800	290	1900	.....	.....	.....
Below Pound Mill Run...	2 mi. above Roaring creek	31	205	16	106	280	412	2700	.....	.....	.....
2 mi. above Roaring creek.	Above Middle fork.....	16½	379	30	197	250	690	4530	12,900	25,800	51,600
Below Middle fork.....	Above Buckhannon river.	3½	596	48	310	155	684	4420	11,200	22,400	44,800
Below Buckhannon river.	Below Frog run.....	23	1080	86	520	320	2530	15,300	40,200	80,400	160,800
Below Frog run.....	Above West Fork river...	28	1320	106	630	135	1310	7820	18,800	37,600	75,200
Monongahela River											
Below West Fork river...	Lower pool, Dam No. 9..	31	2500	150	940	73	1000	6300	15,600	31,200	62,400
Totals	.....	152				3013	6916	42,970	98,700	197,400	394,800

a—Total area; b—Continuous horsepower if all utilized in each period.

Table No. 15. Indicated Horsepower Developed by the Minor Tributaries of the Monongahela River.

Stream.	Section. From	Section. To	Length. Miles.	Mean Drainage Area....	Minimum Discharge	Assumed discharge for maximum development	Total Fall. Feet	Minimum Horsepower .	Assumed Maximum Development. Horsepower .
				Sq. mi.	Sec.-ft.	Sec. ft.			
Middle fork	Source	Below Cassidy fork	15	a 65	5	34	1,200	138	940
Middle fork	Below Cassidy fork	Mouth	25	113	9	59	540	447	2,930
Buckhannon river	Source	Alexander	17	a 90	7	47	1,300	209	1,410
Buckhannon river	Alexander	¼ mi. above Sand run	33	200	16	104	470	692	4,490
Buckhannon river	¼ mi. above Sand run	Mouth	11	330	26	171	60	144	944
Sandy creek	Source	Mouth	20	a 84	7	44	1 000	161	1,010
Three Fork creek	Source	Mouth	25	a 98	8	51	1,000	184	1,170
West Fork river	Source	Below Washburn run	22	a105	4	19	500	46	218
West Fork river	Below Washburn run	Tygart river	70	475	17	88	160	250	1,300
Buffalo creek	Source	Monongahela river	55	a130	4	24	400	37	221
Deckers creek	Source	Monongahela river	25	a 57	2	10	790	36	182
Dunkard creek	Source	Monongahela river	35	a200	7	37	400	64	340
Totals								2,408	15,155

a – Total area.

Table No. 13. Indicated Horsepower Developed by Cheat River.

Section of River.		Length. Miles.	Mean Drainage Area.....	Minimum Discharge	Assumed discharge for Maximum Development	Total Fall. Feet	Minimum Horsepower .	Assumed Maximum Development Horse-power .	Horsepower (b) Available From Storage For		
From	To								12 mos.	6 mos.	3 mos.
			Sq. mi.	Sec.-ft.	Sec.-ft.						
Source	3000-ft. contour	30	a 88	24	59	b1500	826	2,030	.....	.....	.....
3000-ft. contour	Above Dry fork.....	45	151	41	101	1370	5,160	12,700	.....	.....	.....
Below Dry fork..	Albright	45	865	151	545	440	6 120	22,100	21,100	42,200	84,400
Albright	Mouth	29	1220	214	770	400	7,880	28,300	27,200	54,400	108,800
Totals	.....	149				3710	19,986	65,130	48,300	96,600	193,200

a—Total area; b Fall reduced to 280 feet by proposed Cheat river reservoir.

Present Development.

Hydro-Electric Company of West Virginia.—As mentioned in Chapter II., the Hydro-Electric Company of West Virginia, formerly known as the West Virginia Development Company, has already begun the construction of a great dam about 80 feet high on Cheat river within the territory of this report, located about 500 feet southeast of the Pennsylvania-West Virginia State line, and a similar dam is projected by the same company on this river near Beaver Hole at the Monongalia-Preston county line. The air line distance of Morgantown from the Cheat Haven dam is 8 miles, and to the Beaver Hole dam, 9 miles. An account of the first mentioned dam as given on page 37 of the Industrial Supplement of the Post-Chronicle, Morgantown, W. Va., under date January 16, 1913, and subsequently revised by F. W. Scheidenhelm, Chief Engineer of the Hydro-Electric Company, is as follows:

"The power plant is located on Cheat river near Cheat Haven, Pa., just up-stream from the Pennsylvania-West Virginia state line. The dam and power house are being built of concrete, the dam to have a height of 80 feet and a length of about 1000 feet. As a protection against floods the upper 20 feet of the dam will consist of a series of 26 huge gates 17 feet high, which in times of emergency can be opened wide permitting a discharge of more than 150,000 cubic feet per second. Such an amount of water would be far in excess of the worst Cheat river flood on record, that of the year 1888. Ordinarily only as many gates will be opened as are necessary to pass the excess water which cannot be utilized for power, the manipulation of the gates being for the purpose of keeping the level of the water in the large reservoir above the dam at practically the same elevation at all times. The effect of this regulation on the river flow and the constant use of water for power production will materially supplement the extreme low water in both the Cheat river and Monongahela river, resulting in the maintenance of the coal stage in the latter throughout the year, and in prolonging the coal stage in the Ohio river for a considerable length of time. On the other hand during periods of extreme high water the reservoir will tend to ameliorate flood conditions at Point Marion.

"The power house, a building about 234 feet in length and 100 feet in width, is being erected as a portion of the dam structure near the right bank of the river. The plant will consist of an equipment of four water turbines capable of developing 12,000 H. P. each thus placing the total installed capacity of the plant at 48,000 H. P. Each of the powerful hydro-electric units will weigh in the neighborhood of 250 tons.

"In order to be able to guarantee to its customers steady and reliable power even during seasons of drought, the Hydro-Electric Company is arranging with the West Penn Traction Company to connect its transmission lines with those of that Company. Thus when the water supply is inadequate to generate sufficient power to meet

demands, the deficiency can be made up by drawing upon the output of the steam plant of the Traction Company, located on the Youghiogheny river one mile above Connellsville, Pa.

"One feature of this large hydro-electric development which will add materially to the attractions of the already picturesque Cheat River Valley, is the magnificent body of water that will be backed up by the dam. The artificial lake, thirteen miles in length, will be the largest body of water in the region, and certainly the most attractive, within easy reach of Pittsburgh. The possibilities that this offers in the way of boating and fishing will surely be appreciated by the constantly growing number of summer visitors to this beautiful resort."

FORESTS.

In Vol. V., Chapter VI., of the State Geological Survey Reports, published in 1911, A. B. Brooks, State Forester, gives a detailed description of the forests of the State by counties. As that publication is available, only such portions as relate to present forest conditions will be republished here.

Present Forest Conditions—Monongalia County.

"Areas of virgin forest aggregating about 7,600 acres still remain on the waters of Cheat river and Deckers creek in the eastern end of the county. The principal tract, containing approximately 5,000 acres, lies on the east of Cheat river and adjoins the forests of Preston county. Several hundred acres of virgin forest which is not heavily timbered lies on the steep faces of the Cheat river mountains, and areas of less extent lie on the hills on both sides of Deckers creek. The cut-over forests, containing about 11,000 acres, also lie in the same region.

"The remainder of the county is divided up into farms which are partly cleared and partly wooded. As a rule, the farmers' woodlots have but little timber."

Present Forest Conditions—Marion County.

"From 80 to 90 per cent of the county is cleared land. The woodland contains only a little good timber and is owned by farmers who hold it for domestic purposes in connection with their farms. In parts of Mannington and Lincoln districts, especially, there are woodlots of considerable size which contain valuable stands of hardwoods."

Present Forest Conditions—Taylor County.

"Farmers own all the land of the county, and the forest land remaining is in scattered woodlots. In some sections at least 75 per cent of the land is cleared. This is true in the best agricultural areas adjoining Harrison and Barbour counties. In other sections the percentage of cleared land is much smaller, and here the farmers have reserved considerable good timber. Many woodlots, it is said, have 5,000 feet per acre of sound oak, hickory, and other timber, still standing on them."

CHAPTER XIV.

SOIL SURVEY OF THE MORGANTOWN AREA

(Monongalia, Marion and Taylor Counties.)

By Charles N. Mooney and W. J. Latimer.

CLIMATE.

The following tables, giving meteorological data for the area, were secured from Mr. H. C. Howe, Section Director, United States Weather Bureau, Parkersburg, W. Va., and as they are more complete than those given by Messrs. Mooney and Latimer, they replace the tables given on page 8 of their report on the Soil Survey of these counties which is herein quoted in full from page 9:

Monthly and Annual Mean Temperatures at Morgantown.

(Horace Atwood, Observer).

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.	Average
1892....	28.4	37.0	36.2	47.7	....	....	76.6	73.4	65.4	51.6	41.8	30.8	....
1893....	22.8	36.0	41.6	52.8	....	71.6	74.5	72.8	....	55.3	40.3	34.6	....
1894....	34.8	32.6	44.8	....	64.2	65.6	73.4	71.6	70.4	53.5	43.9	36.7	....
1895....	29.5	22.1	38.2	52.4	....	....	70.0	73.0	69.7	46.2	43.8	35.8	....
1896....	31.0	32.4	33.4	56.6	68.2	70.0	73.6	....	65.9	51.6	45.5	35.0	....
1897....	29.6	36.5	46.0	51.5	56.4	67.8	75.2	70.1	67.8	59.4	44.9	38.1	53.6
1898....	37.6	33.4	47.8	46.8	62.6	71.4	75.2	75.1	71.2	56.5	42.2	....	....
1899....	30.6	26.0	41.6	53.8	64.4	71.4	74.3	74.5	65.2	....	46.1	....	....
1900....	35.6	31.0	37.8	50.7	63.2	72.0	75.4	76.9	72.2	61.0	45.4	34.2	54.6
1901....	33.2	24.6	42.5	46.5	61.6	70.8	77.6	72.8	66.9	55.4	36.5	32.6	51.8
1902....	29.4	25.1	44.3	49.4	64.2	67.8	73.6	69.0	65.4	57.2	52.2	33.2	52.6
1903....	31.7	33.8	50.8	52.2	65.0	64.6	72.2	71.4	66.7	56.4	38.6	27.2	52.6
1904....	27.2	28.4	43.2	47.6	63.0	69.5	71.0	70.2	67.6	55.6	41.7	31.6	51.4
1905....	25.6	24.8	46.4	51.0	62.5	69.7	73.3	71.2	66.6	55.6	41.6	36.0	52.0
1906....	39.4	31.6	36.7	53.6	62.9	70.3	72.1	74.6	69.8	54.8	44.2	35.4	53.8
1907....	36.6	29.4	48.4	44.0	57.6	64.5	71.2	69.0	66.0	49.7	41.6	35.2	51.1
1908....	31.6	30.1	47.0	53.2	62.0	68.2	73.6	71.0	68.8	55.4	44.1	35.6	53.4
1909....	37.4	40.0	39.7	52.4	60.6	70.8	70.5	71.7	65.2	51.2	50.5	28.0	53.2
1910....	32.2	31.8	51.2	53.9	57.8	65.6	73.8	71.6	68.2	59.6	37.4	28.4	52.6
1911....	37.4	38.4	39.8	49.6	68.2	70.6	74.0	73.7	69.5	55.6	40.5	40.4	54.8
1912....	23.6	27.7	38.8	55.3	64.6	67.4	74.1	68.8	69.6	56.2	45.0	38.4	52.5
Means..	31.7	31.1	42.7	51.0	62.7	68.9	73.6	72.1	67.9	54.9	43.2	34.1	52.8

Monthly and Annual Precipitation at Morgantown.

(Horace Atwood, Observer).

Year	Jan.	Feb.	Mar.	Apr	May	Jun.	July	Aug.	Sept.	Oct.	Nov	Dec.	Totals
1873...	3.34	5.31	4.01	2.18	4.11	5.68	7.61	4.71	3.52	5.76	3.54	2.99	52.76
1874...	3.17	2.29	3.45	7.20	1.25	4.55	5.75	2.16	5.05	0.24	4.72	5.30	45.11
1875...	3.12	2.74	5.41	2.90	1.69	4.09	7.89	5.58	5.10	3.57	4.18	3.99	50.26
1876...	4.25	3.85	4.97	2.80	3.26	3.00	9.35	3.77	7.16	1.63	2.17	1.95	48.16
1877...	4.26	1.09	3.98	2.51	2.25	6.70	5.80	4.65	2.54	3.53	4.52	1.62	43.45
1878...	3.95	1.20	3.82	2.80	2.87	4.35	3.74	2.50	3.24	3.87	5.95	4.84	43.13
1879...	3.41	2.38	4.56	1.47	1.35	4.64	7.10	6.62	1.27	1.62	2.24	6.70	43.36
1880...	5.77	4.53	5.10	4.30	2.24	6.66	3.80	7.25	3.18	3.07	1.99	3.99	51.88
1881...	3.07	3.56	2.12	2.30	3.28	4.77	5.61	0.41	2.78	4.55	3.19	5.93	41.58
1882...	6.78	5.41	7.18	3.36	4.51	3.39	3.64	7.72	7.23	1.86	2.28	1.92	55.28
1883...	4.93	7.07	4.01	....	....	....	....	....	....	....	....	....	.....
1884...	....	....	....	....	....	....	....	....	....	....	....	....	.....
1885...	4.75	2.62	1.60	3.31	....	6.18	2.78	7.43	1.45	5.07	2.75	2.39	.....
1886...	4.01	2.26	3.15	4.50	6.46	7.00	4.29	5.55	3.51	1.51	4.02	....	.....
1887...	1.33	6.28	1.32	3.35	1.16	3.08	2.96	4.32	3.19	0.81	1.37	1.55	30.72
1888...	6.85	2.34	3.77	2.39	5.82	3.73	7.29	8.70	5.03	7.14	4.90	1.92	59.88
1889...	2.75	2.68	3.09	4.97	6.37	4.47	5.12	1.61	3.91	3.34	7.87	2.85	49.03
1890...	5.83	5.87	5.84	4.13	8.10	6.83	3.41	7.08	7.71	8.20	2.67	3.87	69.54
1891...	3.93	6.31	4.15	2.72	3.20	6.08	7.52	7.45	3.20	2.59	3.68	3.82	54.65
1892...	3.64	2.05	4.68	3.02	5.28	3.15	6.97	1.81	1.42	1.30	2.89	2.38	38.59
1893...	2.97	5.05	1.02	5.46	3.38	1.94	1.66	1.34	2.20	2.89	2.38	2.14	32.43
1894...	2.45	3.56	1.57	2.95	1.03	1.70	3.07	1.77	2.52	3.14	3.47	3.83	31.06
1895...	4.74	1.45	1.77	2.48	1.39	5.55	2.82	2.18	1.25	1.02	1.65	1.85	28.15
1896...	0.96	3.74	3.35	1.68	3.57	4.16	9.80	1.91	3.78	3.08	4.17	1.36	41.56
1897...	2.35	3.94	3.88	3.80	4.91	5.77	5.55	3.04	1.23	0.29	5.24	2.77	42.77
1898...	5.78	1.68	6.20	4.86	4.78	5.17	4.01	7.91	2.79	5.56	2.67	0.71	52.12
1899...	4.37	5.67	6.63	1.94	4.72	6.43	3.38	1.78	2.26	0.50	0.35	3.50	42.53
1900...	1.59	2.96	3.59	1.51	2.14	5.39	6.93	4.33	0.48	3.91	5.06	1.54	39.43
1901...	1.96	0.55	3.67	6.15	6.10	2.34	1.86	7.37	3.68	0.36	3.02	5.57	42.63
1902...	3.63	2.48	3.92	3.48	1.72	7.16	8.42	4.87	3.24	3.95	2.24	6.12	51.23
1903...	2.87	6.47	4.28	3.55	4.12	5.21	5.46	1.34	1.21	3.21	2.26	1.70	41.68
1904...	2.70	2.02	4.32	2.86	2.91	5.55	4.50	2.18	1.38	1.74	0.15	2.56	32.87
1905...	3.48	1.75	5.13	3.38	3.63	3.94	5.36	4.16	1.96	4.98	2.48	3.85	44.10
1906...	3.92	1.58	3.73	4.10	3.14	4.52	3.57	2.93	2.85	3.14	1.62	5.48	40.58
1907...	7.51	2.24	6.97	2.79	4.06	4.33	9.36	2.62	4.97	3.44	3.05	3.04	54.38
1908...	2.23	3.19	6.04	3.28	6.04	2.74	3.55	1.29	0.70	0.53	0.82	2.26	32.67
1909...	4.07	3.85	2.48	5.20	2.80	5.18	3.11	2.52	1.32	2.55	0.83	2.00	35.91
1910...	6.70	2.63	0.36	2.06	3.69	4.89	4.08	2.32	3.34	1.77	2.24	2.13	36.21
1911...	6.87	1.37	2.54	4.87	1.79	4.98	4.23	10.11	5.73	5.65	1.98	4.03	54.15
1912...	2.43	2.60	6.59	3.37	2.79	3.42	11.17	2.44	3.26	1.10	1.28	1.95	42.40
Means.	3.92	3.30	3.95	3.42	3.57	4.70	5.33	4.15	3.17	2.96	2.94	3.15	44.56

Snowfall at Morgantown.

(Horace Atwood, Observer).

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1893	19.3	2.0	3.5	0.	....	....	....	....	....	....	....	....
1894	....	....	....	....	....	....	....	....	....	....	0.5	17.0
1895	8.8	14.5	0.6	0.	....	....	....	....	....	....	0.	1.3
1896	0.8	2.8	21.8	0.2	....	....	....	....	....	....	0.	4.8
1897	1.4	0.1	T	0.	....	....	....	....	....	....	T	2.5
1898	3.2	2.0	T	3.4	....	....	....	....	....	....	2.0	3.2
1899	9.3	12.8	3.8	T	....	....	....	....	....	....	....	....
1900	0.2	5.0	10.8	0.	....	....	....	....	....	....	0.2	T
1901	6.5	3.0	1.0	6.0	....	....	....	....	....	....	3.5	2.0
1902	12.0	6.0	20.0	18.0	....	....	....	....	....	....	T	17.0
1903	8.0	7.6	T	T	....	....	....	....	....	....	3.0	13.0
1904	14.0	4.0	1.5	1.0	....	....	....	....	....	T	T	9.0
1905	25.5	....	....	2.0	....	....	....	....	....	....	T	1.0
1906	6.0	7.0	10.0	T	T	....	....	....	....	T	10.	11.5
1907	8.0	9.0	5.0	3.0	....	....	....	....	....	.0	T	6.0
1908	10.0	3.0	3.0	T	T	....	....	....	....	.0	4.0	2.0
1909	8.0	T	4.5	1.6	T	....	....	....	....	T	T	6.0
1910	14.0	9.0	T	T	.0	....	....	....	....	T	7.0	17.0
1911	7.0	T	7.0	4.5	.0	....	....	....	....	.0	T	3.0
1912	15.5	7.5	7.0	T	.0	....	....	....	....	.0	0.5	6.0
Means	9.3	5.3	5.5	2.1	T	....	....	....	....	T	1.2	6.8

Monthly and Annual Mean Temperature at Fairmont.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1905	....	....	47.1	52.8	63.5	70.4	74.2	70.2	65.2	53.2	41.0	35.4	....
1906	40.2	32.1	37.8	53.1	62.5	71.9	72.7	75.6	68.4	54.5	44.4	35.8	54.1
1907	37.2	30.8	50.0	45.8	59.1	65.3	73.5	70.2	66.2	49.2	42.5	36.9	52.2
1908	32.2	32.0	48.0	55.1	63.0	70.5	75.1	71.6	66.6	55.4	42.1	35.6	53.9
1909	37.0	40.0	40.8	52.6	61.0	72.3	71.4	72.4	65.3	49.9	48.2	28.4	53.3
1910	31.7	34.8	....	....	58.1	68.0	75.8	73.7	69.8	59.5	38.0	28.1	....
1911	37.7	38.9	41.5	50.9	67.7	73.5	76.4	76.2	71.3	58.0	....	38.8	....
1912	21.4	26.4	38.9	55.1	64.4	69.0	76.2	70.8	70.8	55.7	42.4	34.2	52.1
Means	33.9	33.6	43.4	52.2	62.4	70.1	74.4	72.6	68.0	54.4	42.7	34.2	53.5

Monthly and Annual Precipitation at Fairmont.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
1892	4.00	2.31	2.78	3.56	4.90	3.62	4.39	2.79	2.31	1.02	3.56	2.20	37.44
1893	2.76	5.25	1.05	6.21	3.64	3.97	2.42	2.79	2.20	3.34	2.48	1.82	37.93
1894	2.03	3.53	1.81	3.51	3.45	4.23	2.96	1.57	2.19	2.40	2.38	4.59	34.65
1895	5.81	1.08	4.15	2.76	1.58	4.08	2.69	3.28	1.10	0.84	2.92	2.33	32.62
1896	1.16	2.79	4.48	1.57	5.92	4.59	13.3	2.64	4.41	2.95	3.13	2.29	49.26
1897	1.94	5.47	3.32	3.42	4.46	3.83	3.38	2.60	0.62	0.12	6.35	4.63	40.14
1898	4.99	2.10	6.10	4.40	4.71	3.36	3.10	7.40	2.47	5.81	2.66	2.77	49.80
1899	4.44	3.34	5.67	2.27	5.57	5.59	5.81	3.01	3.68	0.43	3.18	2.87	45.86

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
1900...	2.49	3.42	4.14	1.38	2.99	5.47	5.08	3.45	0.43	4.33	5.59	2.34	41.11
1901...	2.52	0.67	3.54	6.68	6.24	5.46	1.91	2.92	4.29	0.38	3.23	6.02	43.86
1902...	3.20	2.54	4.18	4.16	2.26	4.30	5.97	2.09	4.34	3.81	3.16	6.74	46.75
1903...	2.76	4.94	5.40	3.46	2.62	5.88	6.58	1.74	1.34	2.87	2.70	1.80	42.09
1904...	2.56	1.90	4.91	3.14	3.10	6.11	2.89	2.51	1.69	1.78	0.44	2.98	34.01
1905...	3.53	1.76	6.26	2.80	4.44	4.10	8.70	5.19	2.81	6.16	2.63	3.90	52.28
1906...	4.24	1.62	4.92	4.92	1.59	5.74	3.80	4.26	1.98	2.03	1.87	5.38	42.35
1907...	7.70	3.53	5.89	2.71	5.84	4.64	6.83	6.15	3.80	2.59	3.89	3.11	56.68
1908...	2.30	3.90	6.61	3.28	5.95	4.04	3.93	2.15	0.97	1.25	0.79	2.67	37.84
1909...	3.73	5.63	3.43	6.11	4.51	7.45	3.30	2.18	2.10	2.26	0.72	2.43	43.85
1910...	8.01	2.72	0.35	2.17	3.92	4.14	5.53	2.83	4.71	1.55	1.90	2.90	40.73
1911...	6.25	1.91	2.52	4.28	1.28	4.89	3.50	8.14	4.37	5.03	1.89	2.15	46.21
1912...	1.73	1.72	6.17	4.04	3.54	3.79	5.89	2.02	4.41	0.97	1.20	2.39	37.87
Means.	3.72	2.96	4.18	3.66	3.93	4.73	4.86	3.41	2.68	2.47	2.70	3.25	42.55

Snowfall at Fairmont.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1899.....	....	....	....	....	....	....	....	....	....	....	T	3.0
1900.....	2.5	6.2	9.5	T	....	....	....	....	....	....	3.0	T
1901.....	9.0	4.2	3.8	11.0	....	....	....	....	....	....	2.5	2.5
1902.....	10.5	7.8	16.5	15.0	....	....	....	....	....	....	T	15.1
1903.....	6.0	8.9	T	0.	....	....	....	....	....	....	1.0	4.4
1904.....	....	3.1	0.5	0.5	....	....	....	....	....	....	T	9.5
1905.....	22.5	2.4	0.8	T	....	....	....	....	....	....	T	2.0
1906.....	3.0	6.5	18.3	0.	....	....	....	....	....	....	T	2.0
1907.....	3.5	8.0	10.0	T	....	....	....	....	....	....	1.0	5.5
1908.....	16.8	9.0	T	0.5	....	....	....	....	....	....	4.0	2.5
1909.....	4.5	0.4	1.0	1.0	....	....	....	....	....	....	T	6.4
1910.....	12.0	11.5	T	0.	....	....	....	....	....	T	T	14.0
1911.....	4.0	5.6	4.0	2.0	....	....	....	....	....	....	T	0.5
1912.....	10.2	5.9	3.3	T	....	....	....	....	....	....	0.4	7.0
Means.....	8.7	6.1	5.2	2.3	....	....	....	....	....	T	0.8	5.3

Monthly and Annual Mean Temperatures at Mannington.

Year	Jan.	Feb.	Mar.	Apr	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1901...	....	....	44.2	48.0	61.6	71.6	78.7	74.4	65.2	54.6	38.1	33.6	....
1902...	30.7	26.0	....	....	....	....	....	....	....	....	....	....	....
1903...	....	....	52.4	52.4	64.2	65.1	72.4	71.8	....	53.2	36.4	25.8	....
1904...	25.4	28.0	44.4	48.0	61.3	69.0	71.2	69.6	65.6	52.4	40.7	31.3	50.6
1905...	25.9	24.8	44.9	52.8	62.8	70.4	....	....	65.2	54.1	39.8	....	....
1906...	....	....	....	54.0	61.8	69.8	71.4	74.7	69.2	54.8	43.2	35.4	....
1907...	36.6	29.9	49.8	46.2	58.3	65.0	71.6	68.4	65.8	49.5	40.0	34.4	51.3
1908...	29.6	31.1	46.9	54.2	62.8	69.0	74.3	71.2	65.8	54.4	40.6	34.8	52.9
1909...	35.6	39.5	40.9	52.7	60.8	71.2	70.1	71.0	64.2	48.8	47.4	27.0	52.4
1910...	30.7	31.3	49.0	53.2	57.4	66.2	73.2	70.3	66.8	57.3	36.6	27.2	51.6
1911...	34.9	34.2	34.4	49.0	64.4	69.5	72.6	73.0	67.6	55.4	40.0	38.9	52.8
1912...	23.0	26.4	39.2	54.0	62.0	65.9	72.6	68.0	67.5	54.4	42.0	35.7	50.9
Means.	30.3	30.1	44.6	51.3	61.6	68.4	72.8	71.2	66.3	53.5	40.4	32.4	51.9

Monthly and Annual Precipitation at Mannington.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
1901	.....	0.75	2.81	8.55	5.74	3.11	4 35	3.93	3.38	0.20	5.35	3.69	....
1902	2.71	1.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
1903	.....	.....	3.40	3.61	3.26	6.62	4.81	1.73	....	2.20	2.63	1.68	....
1904	1.95	1.83	5.14	3.29	3.29	4.60	2.57	4.36	2.38	1.48	0.33	2.54	33.76
1905	3.61	1.50	4.83	3.01	3.97	3.08	....	....	2.71	5.35	....	....	....
1906	.....	.....	.....	4.52	2.66	4.49	4.76	4.82	2.27	2.72	1.99	5.07	....
1907	8.33	2.70	5.89	3.14	4.99	4.95	6.78	3.58	3.87	2.57	3.04	3.67	53.51
1908	2.31	3.55	5.86	3.53	5.62	2.03	4.56	2.86	1.42	1.29	0.80	3.25	37.08
1909	3.76	5.04	3.90	5.34	3.67	5.18	3.12	3.00	1.44	2.19	0.71	2.93	40.28
1910	7.02	3.42	0.15	2.32	4.64	3.11	4.92	2.07	4.98	1.51	2.53	2.59	38.37
1911	7.78	2.24	3.07	5.65	1.69	3.14	4.66	6.72	5.99	4.77	2.51	4.09	52.31
1912	2.06	2.47	6.14	5.23	2.84	4.21	9.39	2.03	5.57	1.19	1.52	3.00	45.65
Means.	4.39	2.53	4.12	4.38	3.85	4.05	4.90	3.51	3.40	2.32	2.14	3.25	42.84

Snowfall at Mannington.

Year	Jan.	Feb.	Mar	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1901	....	6.0	0.4	3.0	0.	....	....	....	....	0.	3.2	3.0
1902	11.0	....	.....	.....	....	....	....	....	.....	.....	....	....
1903	.....	.....	.....	T	0.	....	....	....	....	T	....	5.0
1904	7.8	2.3	0.8	1.0	0.	....	....	....	....	0.	0.7	9.0
1905	23.9	4.8	1.2	T	0.	....	....	....	....	0.	....	....
1906	....	....	....	0.	0.	....	....	....	....	2.1	2.8	5.5
1907	7.2	11.9	3.1	7.8	....	....	....	....	....	0.	1.0	4.7
1908	9.4	10.0	1.6	0.1	T	....	....	....	....	0.	2.7	6.8
1909	11.8	1.9	5.3	1.6	T	....	....	....	....	0.	0.6	10.2
1910	21.3	13.3	0.2	0.5	0.	....	....	....	....	0.4	2.9	14.1
1911	4.5	2.6	8.0	3.4	0.	....	....	....	....	0.	1.8	5.4
1912	10.6	4.5	3.2	0.3	0.	....	....	....	....	0.	0.6	4.9
Means	11.9	6.4	2.6	1.6	T	....	....	....	....	0.2	1.8	6.9

Monthly and Annual Mean Temperatures at Grafton.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept	Oct	Nov	Dec	Average
1892	26.2	35.8	35.9	50.2	62.1	75.2	73.7	72.2	64.4	51.8	40.1	30.0	51.5
1893	22.3	34.9	41.0	54.3	60.0	69.8	73.2	70.2	65.6	55.0	41.4	26.4	52.0
1894	37.0	32.8	46.5	50.0	61.9	69.5	72.0	70.4	68.8	55.6	39.0	36.0	53.3
1895	28.2	20.1	38.7	52.4	61.0	72.0	68.9	72.2	69.5	48.6	46.0	36.0	51.1
1896	30.8	31.3	33.4	59.2	68.2	69.2	72.3	71.8	65.4	50.3	46.8	34.0	52.7
1897	27.4	35.4	45.4	50.4	56.2	67.7	73.4	69.5	65.5	58.8	43.2	35.6	52.4
1898	34.8	32.2	47.8	46.2	62.0	69.7	73.7	72.6	67.0	55.6	42.8	33.8	53.2
1899	34.0	26.4	42.6	53.2	64.0	70.1	72.8	72.2	63.1	57.8	45.6	32.7	52.9
1900	34.0	29.4	36.4	51.0	62.0	70.4	73.5	74.4	70.6	59.5	45.0	33.1	53.3
1901	31.9	23.4	42.0	44.8	59.1	68.9	76.1	72.1	63.4	53.8	35.4	32.9	50.3
1902	29.2	25.2	43.8	48.8	63.8	65.8	72.8	69.0	64.7	56.4	51.1	33.4	52.0
1903	32.6	33.3	51.2	51.6	64.8	64.2	71.6	71.2	65.4	54.4	38.3	26.4	52.1
1904	28.4	29.6	44.2	47.8	61.8	69.0	70.6	69.9	67.4	54.9	41.2	32.8	51.5
1905	25.7	25.1	46.4	51.8	63.7	70.0	73.1	71.4	65.5	54.8	42.0	36.2	52.1
1906	39.0	32.4	37.6	53.0	61.9	69.8	72.2	75.4	70.0	55.2	44.2	36.2	53.9
1907	38.6	30.8	49.8	45.0	58.4	64.8	71.1	68.6	66.1	49.6	42.0	36.1	51.7
1908	31.6	31.4	47.4	53.8	62.2	68.0	73.8	70.6	66.8	56.5	43.9	35.7	53.5
1909	37.4	40.3	40.6	53.2	....	....	....	71.6	64.6	50.3	49.0	28.5	....
1910	32.6	32.2	50.1	53.8	58.6	67.0	74.1	70.3	68.8	58.6	37.0	27.9	52.6
1911	38.0	40.2	42.6	50.2	66.2	71.4	74.9	74.4	70.2	58.7	42.2	41.7	55.9
1912	25.4	27.7	41.2	56.5	65.2	68.7	74.4	70.2	70.4	57.1	43.3	38.0	53.2
Means.	31.7	30.9	43.1	51.3	62.2	69.1	72.9	71.4	66.8	54.9	42.8	34.0	52.6

Monthly and Annual Precipitation at Grafton.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
1891	....	....	....	....	....	....	.....	.....	....	2.12	2.90	3.40	.....
1892	4.69	2.87	2.57	4.56	5.37	2.67	3.32	1.87	3.39	1.45	3.91	3.00	39.67
1893	2.57	4.73	1.13	7.17	4.07	4.06	3.68	1.76	1.51	2.95	2.59	1.71	37.93
1894	2.51	3.84	1.82	4.13	3.98	2.96	4.34	3.05	1.73	2.32	2.40	4.74	37.82
1895	4.67	1.24	3.80	4.15	1.65	4.58	3.65	3.48	0.44	1.61	2.27	2.23	33.77
1896	1.50	2.96	4.70	2.18	4.84	4.01	11.91	2.22	4.68	2.83	3.38	2.00	47.21
1897	2.21	5.27	3.43	3.10	4.81	5.15	6.24	2.82	0.65	0.32	4.89	4.96	43.85
1898	5.58	2.45	7.14	4.05	4.73	4.48	4.36	6.85	1.87	4.92	3.34	2.45	52.25
1899	4.87	3.43	5.51	1.84	4.71	6.33	4.68	2.10	4.74	1.21	3.34	3.22	45.93
1900	2.17	3.95	3.77	1.66	2.72	5.40	5.09	5.40	0.98	3.63	6.18	2.55	43.50
1901	2.53	0.73	3.63	6.51	6.50	9.37	3.32	5.30	3.56	9.43	3.12	4.44	49.44
1902	3.82	2.38	5.14	3.50	5.02	5.68	4.82	4.80	4.68	2.92	3.11	6.86	52.74
1903	2.57	5.65	5.77	3.70	3.74	4.96	3.75	2.28	1.49	3.42	3.62	2.28	43.23
1904	2.54	2.22	5.36	3.77	2.60	4.94	1.60	3.45	2.94	1.55	0.30	2.93	34.20
1905	3.28	1.44	5.78	4.13	4.81	5.05	7.92	5.57	2.34	5.08	2.85	3.15	51.40
1906	3.27	1.61	5.57	5.05	2.99	4.76	2.30	3.07	2.67	2.98	2.56	5.59	42.42
1907	2.70	2.98	5.43	2.41	5.12	4.40	8.01	5.61	5.94	4.09	3.92	3.38	58.99
1908	2.23	3.66	6.65	3.76	7.65	2.87	4.48	2.29	0.74	0.50	0.70	2.94	37.97
1909	3.80	4.82	2.76	5.09	....	....	.....	3.18	2.64	3.45	1.23	2.52	.....
1910	9.02	4.80	0.38	2.94	3.78	4.17	5.15	2.01	4.41	2.64	3.57	3.94	46.81
1911	8.36	2.58	2.94	4.45	1.47	4.19	5.02	11.50	5.44	5.26	1.91	3.70	56.82
1912	3.40	2.95	6.56	3.95	3.79	3.45	7.14	3.13	5.02	1.56	1.84	3.51	46.30
Means	3.73	3.17	4.28	3.91	4.22	4.67	5.04	3.89	2.95	2.60	2.91	3.43	44.80

Snowfall at Grafton.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1893	25.2	4.0	7.5	1.5	....	....	....	....	....	....	1.5	3.2
1894	11.5	21.3	2.0	1.5	....	....	....	....	....	....	4.2	....
1895	17.0	13.1	16.2	0	T	....	....	....	....	....	0.8	6.8
1896	2.6	7.0	27.6	0.5	....	....	....	....	....	T	T	3.5
1897	8.8	3.6	4.1	T	2.2	....	....	....	....	....	0.5	4.3
1898	4.0	8.9	10.0	4.9	....	....	....	....	....	T	6.9	10.5
1899	10.0	13.5	5.0	T	....	....	....	....	....	....	T	3.5
1900	2.0	9.0	12.5	T	....	....	....	....	....	....	3.0	T
1901	9.0	4.2	3.8	11.0	....	....	....	....	....	....	5.0	5.5
1902	14.2	9.5	19.8	22.0	....	....	....	....	....	T	1.5	16.0
1903	5.8	9.8	T	T	T	....	....	....	....	T	10.5	12.5
1904	14.9	8.0	1.6	3.0	....	....	....	....	....	....	2.0	11.3
1905	26.2	8.2	0.8	1.5	....	....	....	....	....	T	0.2	2.8
1906	4.0	6.0	16.5	0.5	T	....	....	....	....	5.0	3.5	10.5
1907	6.0	11.0	5.0	4.0	0	....	....	....	....	0	1.0	5.5
1908	16.8	9.0	T	0.5	0	....	....	....	....	0	4.2	5.6
1909	10.9	3.0	3.5	1.5	T	....	....	....	....	0	T	6.7
1910	11.0	13.5	0.2	0	0	....	....	....	....	1.0	3.0	18.5
1911	10.0	7.5	2.1	T	0	....	....	....	....	0	1.0	....
1912	16.8	5.0	5.2	0	0	....	....	....	....	0	T	5.0
Means	11.3	8.8	6.7	2.6	0.1	....	....	....	....	0.3	2.4	7.3

Highest Temperatures.

Stations	Length of Record Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Grafton.....	18	75	80	84	92	92	99	96	96	98	91	79	71	99
Mannington...	12	70	68	87	91	93	99	101	98	94	88	79	70	101
Morgantown..	18	76	80	90	93	94	99	101	105	102	94	80	80	105

Lowest Temperatures.

Stations	Length of Record Years	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Grafton.....	18	-15	-27	0	9	21	38	42	42	31	17	7	-5	-27
Mannington...	12	-31	-18	-5	16	25	34	45	40	30	17	1	-14	-31
Morgantown..	18	-11	-25	-4	8	28	37	44	44	33	15	9	-16	-25

Frost Data.

Stations	Length of Record. Years...	Average Time of First Killing Frost in Autumn	Average Time of Last Killing Frost in Spring	Earliest Date of Killing Frost in Autumn	Latest Date of Killing Frost in Spring....
Grafton.....	18	Oct. 7	Apr. 30	Sep. 21	May 22
Mannington...	12	Oct. 10	May 6	Sep. 28	May 28
Morgantown..	18	Oct. 13	May 1	Oct. 2	May 22

These figures represent with fair accuracy the average conditions obtaining in the area. The mean annual temperature is 53° F. The summers are pleasant, though in the valleys the temperature is often rather high, though rarely exceeding 100° F. An absolute maximum of 105° F. has been recorded in August and of 102° F. in September. The winters are moderately cold, the seasonal mean being 32°. Sharp cold spells occur, but are of comparatively short duration. The lowest temperature recorded is — 31° F. The average date of occurrence of last killing frost in the spring falls in the first week of May and of the first in the fall in the second week of October. The growing season is thus of sufficient length for all crops grown in this general region to mature.

The mean annual rainfall amounts to 41 inches and the precipitation does not vary much from year to year. It is fairly well distributed, though in later summer and fall droughts occur and in that case it is not infrequently difficult for fall-sown grain and grass to make satisfactory growth before the setting in of cold weather. A part of the precipitation is in the form of snow, the average depth amounting to 29.4 inches, or if reduced to rain somewhat more than 2 inches.

The climate is healthful and numerous summer tourists spend the warm season in the mountainous section of the northeastern part of the area.

AGRICULTURE.

The agricultural development of this section was slow, barely keeping pace with the increase in population, as outside markets were remote and no satisfactory means of transportation existed. Conditions were improved somewhat by the construction of the State road about 1800, which passed through this section, bringing increasing numbers of settlers into the area and making it possible to get more of the products of the farm out by wagon. The construction of other turnpikes followed, and considerable trade passed over these roads.

During this period agricultural production was gradually increasing and the clearing of new land constantly carried on. Corn, wheat, rye, oats, buckwheat, and potatoes were the staple crops, and by 1840 their output had reached considerable proportions. These crops, with exception of rye, have continued the staple crops of the area to the present time. Since 1880 the acreage devoted to rye has decreased rapidly, and only a few acres are now grown in the three counties. The production of corn has increased, and so in general has the production of wheat. The production of buckwheat reached a maximum in Monongalia County in 1859. It is still grown to considerable extent, but the acreage varies greatly from year to year. The production of potatoes has from the first shown a steady increase.

Stock raising dates from the early days of settlement, when cattle and sheep raising was an important industry. The

section is well adapted to grazing, bluegrass being indigenous to at least a part of the soils. Sheep were at first brought in to furnish wool for clothing, but as the climate and grazing were favorable this branch of stock raising became profitable on a larger scale, especially in the western part of the area. The industry reached its highest mark in 1880, and since that time has gradually declined. The fattening of lambs, sheep, and beef cattle has taken the place of wool growing. The limestone land (Westmoreland silty clay loam) and the soils of the Permo-Carboniferous or Dunkard formation (Meigs clay loam) are especially suited to grasses, seeding to bluegrass naturally. The former was largely devoted to cattle grazing, while the latter especially was well suited to sheep.

The tree fruits were introduced shortly after settlement, and the apple especially has thrived, but its production has never exceeded the needs of home consumption.

The development of the oil and gas resources soon after 1890, especially in Monongalia and Marion Counties, has taken much attention from the farms. Much labor has turned to the new fields, and landowners have necessarily curtailed their operations and now depend more upon the rentals and royalties they receive, which in most cases far exceed the profits of the farm. Under these conditions agricultural production has come practically to a standstill, and more land is in grass, although the number of cattle grazed has not increased, for while there is plenty of pasture the number of stock kept is dependent upon the grain and hay that can be produced to feed them through the winter months.

The agriculture of the area is of a mixed type. It is based upon stock grazing, with general farming to produce the crops required to carry the cattle over the winter. The finished beeves form the chief source of income. The average farm, as a rule, does not produce sufficient to meet its requirements, especially of grain, and very little grain or hay is sold at the local markets. Larger quantities are shipped into the area. The production of these staple crops is confined principally to the valleys. The steep hillsides make up most of the grazing lands.

Corn is the main crop and good yields are made on the

bottomland soils. Some of the better upland slopes are also used for this crop. The acreage in this crop is larger than that devoted to any other crop except hay. For the three counties the yield of corn per acre is about 30 bushels. Wheat leads the small grains, the acreage devoted to it being quite constant, and averaging about three-fourths the acreage in corn. According to the census the average yield is about 10 bushels per acre. The oat crop is also important. The average yield is low, however, ranging from 15 to 20 bushels per acre.

The acreage in buckwheat has varied considerably in the past, but is now increasing, as the demand for the flour has made it a profitable crop. It is practically restricted to the eastern part of the area, where the altitude and the soils are better suited to its production than elsewhere. This crop usually follows wheat or oats, being planted in July. Two crops of buckwheat, however, can be taken from the same ground in a single season, and this is done by a few farmers. The yields range from 10 to 35 bushels per acre.

The total production of potatoes is considerable, but the crop is grown mainly in small patches to supply the family needs. In the eastern part of the area it is a more important crop, being grown for the local markets. The supply is not equal to the demand, as potatoes are shipped into the area in large quantities. There is a large area of land that could be devoted to this crop. The Elk silt loam, in the Monongahela Valley will be found particularly well adapted for potato production. At least enough potatoes should be produced to meet the local demands.

The acreage in grass and other forage crops cut for hay is about the same as that devoted to all cultivated crops combined. Timothy, redtop, and clover are the principal hay crops. Clover is usually sown with the other grasses. Redtop is gaining in favor, as it gives good stands. It does not cut so heavy a crop as timothy or orchard grass. On the bottoms and lower slopes, where good moisture conditions prevail, orchard grass is sometimes sown and does well, making a heavy yield of hay. The average yield of hay over the three counties is a little less than 1 ton to the acre. On the bottoms and the more or less calcareous soils the yield is higher, but the

average is lowered by the thinner and inferior soils. The millets are gaining in favor and patches and fields in some sections are quite numerous. The yield is heavy.

Cowpeas are grown to some extent and should receive more attention, as they are a valuable forage crop and a soil improver as well. A few small patches of alfalfa have been tried with indifferent success. On the calcareous soil, with proper treatment, this crop should succeed.

Of the improved land in farms in Monongalia and Taylor Counties about one-fourth is devoted to cultivated crops and grasses cut for hay, while in Marion County the proportion is larger, being about one-third, there being less rough land in this county than in the others. The remaining improved land is probably in more or less permanent pasture.

Some dairying is done in the vicinity of the larger towns, but the supply of milk is barely sufficient to meet the local demands. The purebred Jerseys and Holsteins, the former introduced as early as 1878 and the latter within comparatively recent years, with some good grades constitute the dairy stock.

The high prices for poultry products during the last few years have given a stimulus to this industry and poultry raising is increasing in importance both for egg and meat production.

Apple orchards are said to have existed as early as 1779. Fruit growing in the area, however, has not been developed on a commercial scale. A few trees are to be found on most farms, but only to supply the family. These are not given attention except in a few instances. The few small orchards that are given good cultural treatment and sprayed have proven profitable to the growers. There is a wide range in varieties suited to this section, including the summer, fall, and winter apples. There are plenty of good orchard sites to be found in the area.

Blackberries, raspberries, and strawberries do well in this section, but their growth is limited to small home patches. A few patches of berries produced for market have paid good profits and the small fruits should receive more attention. The high terraces along the Monongahela would be especially adapted to their cultivation.

Vegetables are limited practically to the home gardens.

There is an excellent opportunity to develop trucking in this section, as there is a strong and growing demand for vegetables, which are now shipped in instead of being produced locally. From the first of July until the frost comes growers could meet all outside competition if an effort were made to supply the local markets. The Elk silt loam, a terrace soil, is well suited for producing the truck crops, of which a wide range could be grown. The heavier crops would doubtless prove more profitable because of the local demand for this class of produce.

As noted already the development of the oil and gas resources of the area has diverted interest from farming to a large extent. This is due in part to the labor going into those fields, where high wages are paid. The development of coal mining has had practically no effect upon the supply of farm labor, as the labor in the mines is nearly all performed by foreigners unskilled in farm work. The output of the farms could be increased, however, with the labor still available, should the owners exert themselves in that direction. Where the oil and gas fields are giving out or tests have not disclosed any new deposits the owners are being forced to return to their farming and are taking up the work with renewed interest.

The upland farms are much more difficult to manage than the valley farms, as more hand labor is required. Though improved farm implements are employed wherever possible, there is much land where machinery can not be used. Improved machinery of all kinds is found on the valley farms. On the hillsides contour cultivation is necessary to prevent washing. Great care is necessary in farming slopes, as they wash easily. In the early days very little care was taken to protect the land, as there was plenty of new lands available, so that fields were cropped continuously until "worn out" and then abandoned and soon taken by grass. While some crop their fields continuously, the practice is not favored now. To keep the fields from washing the slopes are kept in grass as much as possible. The roots in newly cleared land and sod will hold the soil for one or two cultivated crops and then it must be seeded to grass. Soil erosion is also lessened by hav-

ing different crops on the slopes. Strips of cultivated ground are alternated with strips in sod. There is thus a kind of crop rotation followed on the upland slopes, but none is strictly adhered to, the period in grass being indefinite. The usual practice is sod land plowed and planted to corn for one season and rarely for two, followed by oats, then by wheat, in which timothy and redtop are sown, and in the spring usually clover The grass is cut for hay until the yields become unprofitable and is then pastured for an indefinite period, usually as long as the grass holds well. Potatoes in the eastern part of the area find a place as a cultivated crop in the rotation with corn. Buckwheat in the eastern part is used as a crop following oats or as a catch crop for areas where some other crop has failed to germinate properly. Shorter crop rotations where the land is easily tilled are advisable and variations in the rotation can be made to suit the different conditions.

On the bottom lands no rotation is practiced, corn being practically the only cultivated crop. Yields are maintained by applications of manure. In the crop rotations on all the soils of the area a legume should always find a place.

The practice of cropping, especially in the early days, was destructive, little thought being given to maintaining the soil fertility. As crop yields later decreased fertilization was resorted to. Barnyard manure was always saved and used, and liming was a common practice. As early as 1855 guano was used with good results, and this was soon followed by commercial fertilizers, consisting of ammoniated phosphates, the phosphate carrier being phosphate rock or bone meal, the latter preferred. An increase in yields of nearly 33 per cent was reported on the depreciated lands. Barnyard manure followed by lime was considered the cheaper treatment and produced the most satisfactory results.

With the development of the mineral resources and decline of agriculture the use of fertilizers, particularly the commercial brands, was discontinued and even liming was not so common. At the present time and on most of the soils of the area, except those of the western section, or the soils derived from the Permian formation (Meigs clay loam) the use of com-

mercial fertilizers has once more become general. On the latter soils it is said the improvement does not warrant the additional expense. The use of fertilizers on the limestone land (Westmoreland silty clay loam) is not common, but on the different soils of the Dekalb series some form of commercial fertilizer is used almost without exception. These Dekalb soils are thin and fertilization is necessary to secure anything like a fair yield. The fertilizer practice, however, has not reached any settled basis, the farmers using different kinds largely upon the advice of dealers. As a result accurate information on this question is not at present available. For corn, wheat, and oats a fertilizer having a formula of 8–2–2 is generally used.

Potatoes are usually fertilized with an 8–4–2 mixture. The proportion of potash should be higher than this in order to get the best results. The same mixture is also used by some for garden vegetables. For grass a fertilizer high in phosphoric acid, with small quantities of potash, is applied by some farmers. Ground bone has from the first been popular for the cereals and grasses. There is considerable variation in proportions of the several salts in the mixtures used for these crops, generally in the quantity of phosphoric acid and to less extent in potash. Very often the fertilizer mixture is made of 8 per cent phosphoric acid, 2 per cent nitrogen, and 2 per cent potash. Fertilizers are used on all crops except on meadows and permanent pastures, the grass getting an application at the time of sowing with small grains. The quantity of fertilizer used in the general practice of the region is small, ranging from 100 to 200 pounds to the acre. Where pastures can not be conveniently broken they may be improved by applications of finely ground rock phosphate or floats.

Experiments conducted by the State experiment station show that phosphates are the controlling factor in the treatment of soils of this region. Potash is necessary in potato production.

The experiment station after a series of trials during a number of years finds the most satisfactory results where the soils had been limed and barnyard manure applied annually.

There is some liming done at present, especially where suitable limestone is found near at hand and can be burned on the place. All the soils, according to the farmers, respond readily to the use of lime. It should be used, however, in connection with applications of organic manures, either barnyard manure or a green manuring crop, preferably a legume. The soils are generally deficient in organic matter and any system of soil management should be planned to supply it in some form. Stable manure should be carefully protected from leaching, and, where this is not possible, it should be spread on the land as rapidly as it is made.

The farms vary considerably in size, from holdings of a few acres to several hundred acres, the average for the three counties, as shown by the last census, ranging between 90 and 100 acres. There has been little change in size for some decades. Renting of farms is not a common practice, the owners either tilling the farms themselves or superintending the work. The census of 1900 shows that of the total number of farms in the area between 80 and 82 per cent are operated directly by the owners themselves. When rented it is usually on a share basis, but the terms of leases vary greatly. A number of farms are operated by hired managers.

Labor is scarce but efficient and commands good wages. Under the present conditions little farm labor is required, except at special seasons, such as harvesting time.

Farm values have increased considerably in the last few years, the surface rights alone bringing now as much as they did formerly when oil, gas, and coal were included. The sale of the oil or gas rights and the rentals and royalties therefrom and the sale of the workable seams of coal have put most farmers in fairly good circumstances. While not working the farms to best advantage, they have improved them by the erection of good dwellings and outbuildings, and consequently there is often an appearance of prosperity which is not in keeping with the character of the land. The value of farm lands ranges from $5 an acre for the poorer and more remote farms to $100 an acre for farms located on better soils near towns. There is very little land on the market.

SOILS.

The soils found in the area fall into two main groups—residual soils of the upland and transported soils of the stream bottoms and terraces. Exclusive of areas of Rough stony land 10 distinct types of soil were mapped.

The upland types are the most extensive, covering fully 90 per cent of the area surveyed. They are derived from the underlying rocks by the ordinary processes of weathering The rock formations are of sedimentary origin and of Carboniferous age. They comprise a great variety of interbedded shales, sandstones, and limestones, including some coal seams. The materials forming these rocks having been deposited by water were laid down horizontally, but during a later period they were given a gentle tilt westward in the area as a whole, and at the same time were bent into a number of low anticlines and shallow synclines. The only one of these strong enough to have any significance in soil formation was the one that formed Chestnut Ridge. When formed it was a ridge and because of this it has been more vigorously attacked by erosion than has the plateau surface on either side of it. It has not yet been reduced to the general level of the surrounding country, but deeper lying rocks have been uncovered along it than elsewhere. These have weathered into soils differing from those found over the plateau in general. The general westward dip of the beds has caused the occurrence on the surface of the younger beds in the western part of the area and of successively older beds eastward.

From the lowest rock exposed in the area—the beds uncovered where the Cheat River Valley cuts Chestnut Ridge—to the highest bed of rock exposed there is a total thickness of about 3,000 feet. This section is made up of five formations, named in the order of their age, from the youngest to the oldest, the Dunkard, Monongahela, Conemaugh, Allegheny, and Pottsville. The Pocono and Pottsville sandstones and the Greenbrier limestone are resistant rocks and give rise to areas of rough stony land of no value except for the forest growth. Thus only the Dunkard, Monongahela, Conemaugh, and

Allegheny formations form soils of agricultural value. The soils thus formed are of silty texture on the surface, with clay loam, silty clay loam, or silty clay subsoils.

These soils are all very similar in texture, but differ somewhat in color and especially in agricultural value. These differences depend mainly upon the character of rocks from which the soils were derived and to some extent upon their general topography.

The Dunkard formation occurs in the western half of Marion and Monongalia Counties. It is composed of interbedded gray and brown shales and sandstones, with thin beds of red shales. The weathering of these rocks gives rise to the Meigs clay loam, which, owing to the different varieties of rocks from which it is derived, varies in color from grayish to light brown, with strips and patches of Indian red. In the eastern part of the area the Dunkard formation has been eroded away, exposing the next underlying formation, the Monongahela. Some Dunkard outliers are found capping the tops of ridges and knobs, but the rock is so much like the upper 100 feet of the Monongahela rocks that the resulting soils are the same for these parts of both formations. These soils have a decidedly yellow subsoil and are designated Dekalb. Shale strata predominate in this part of the formation and give rise to a smoother and more rounded topography than that of the Meigs soil region, and produce also only one type of soil, the silty clay loam.

The rest of the Monongahela formation and part of the Conemaugh in the area, as in the counties immediately south of it, is composed in part of a number of limestone beds and calcareous shales interbedded with gray shales and to a less extent with sandstones. The weathering of these rocks has resulted in a relatively smooth topography. The belt is quite noticeable, aside from its topography, by the generally better growth of grass and the more thrifty appearance of the farms.

These rocks have given rise to gray soils, with yellow subsoils, known in soil classifications of the region as the Westmoreland soils. They are called locally "limestone lands." In this area there is only one type of the series and it is found

along the Monongahela River in Marion and Monongalia Counties and in western and southwestern Taylor County. While a certain part of the Monongahela and Conemaugh formations may be expected to carry limestones, there are exceptions. From Fairmont north on the east side of the Monongahela River the limestones are in part or wholly lacking. East of the Monongahela, where the Pittsburgh coal is rising and is in the tops of the hills, it is capped by massive sandstone, which gives rise to the Dekalb silt loam. Elsewhere where the coal vein is lower limestone is found to 280 feet above the Pittsburgh coal or the top of the Uniontown limestone. This latter is the most constant factor of the type. The limestones are lacking or unimportant as affecting the soils below the Pittsburgh coal formation. Usually, however, the limestone land is found to the horizon of the Clarksburg limestone, 165 feet below the Pittsburgh coal. In southern Marion and in western and southwestern Taylor counties the limestone strata are sufficient to give character to the land to a level 350 feet below the Pittsburgh coal.

The formations below the limestone-bearing strata in this area consist of shales and sandstones, the sandstones as a whole predominating. These give rise to Dekalb soils and on account of the abundance of resistant sandstone present Rough stony land occurs in large areas, though the shales as elsewhere produce fine-grained soils.

As a whole the upland soils in this area exhibit a strikingly close relation to the character of the rock on which they lie. The rock beds dip gently westward. The general upland surface slopes gently westward also, but not so rapidly as the dip of the rock beds. The surface plane therefore cuts the rock planes in such a way that the youngest beds occur in the western part of the county. The underlying formations down to the Pocono sandstone outcrop in successive north-south belts east of this, the most easterly belt being the Pocono belt in Chestnut Ridge.

The highest formations contains a great deal of red shale interbedded with sandstones and gray shales, resulting in an

intimate association of red and gray or yellow soils, which are grouped together as Meigs.

East of this lies a belt of rocks free from red shales. They weather into gray soils with yellow subsoils, the Dekalb. East of this belt lies a belt of alternating shales, sandstones, and thin limestones. These weather into soils indistinguishable in appearance from Dekalb soils, but more productive, the Westmoreland soils. The next belt eastward is free from red shales and limestones and produces Dekalb soils, but the abundance of massive resistant sandstones produce a great deal of stony soil.

The transported soils consist of first bottoms along streams and the high terraces in places bordering the Monongahela and other large streams. The terrace material was deposited when the water stood at higher levels. The original flat surface of these has been more or less dissected by erosion since the stream water dropped to lower levels. The material of the terraces along the Monongahela includes wash from soils derived from limestone, calcareous shales, shales, and sandstones. Such areas have been classed as Elk silt loam The Holston silt loam is very similar to the Elk in color and texture, but it includes less limestone and calcareous shale material, for the soils of the drainage basins of its streams are primarily derived from shale and sandstone. It is found most extensively along Dunkard Creek and in a few places along some of the other larger creeks and the rivers. It is a less productive soil than the Elk silt loam.

The Tyler silt loam is closely associated with the Holston, and, in fact, represents Holston material that has existed under poor drainage conditions. Its development in the Morgantown area is small.

Two first-bottom types have been developed in the area. The more extensive is the Huntington silt loam, formed along streams depositing the wash from limestone, sandstone, and shale soils. The Moshannon silt loam differs in color from the Huntington, the sediments coming from the red materials occurring in the Meigs clay loam having imparted a reddish or reddish-brown color to the alluvial type. Both of these types

are strong, productive soils, and especially adapted to corn and grass. While nowhere do they occur in large bodies, their extent is considerable in the aggregate and they are of great importance to the agriculture of this section.

The following table gives the names and areas of the various soil types mapped:

Areas of Different Soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dekalb silty clay loam	204,480	36.5	Huntington silt loam	12,288	2.2
Meigs clay loam	170,368	30.4	Moshannon silt loam	7,296	1.3
Westmoreland silty clay loam	64,000	11.4	Holston silt loam	3,200	.6
Rough stony land	46,976	8.4	Tyler silt loam	448	.1
Dekalb stony loam	20,224	3.6			
Dekalb silt loam	16,768	3.0	Total	560,000	.....
Elk silt loam	13,952	2.5			

Meigs Clay Loam.

The Meigs clay loam comprises undifferentiated Dekalb and Upshur soils, with some areas of an intermediate type—a Dekalb-Upshur soil. Separation of the several types was impracticable owing to their intricate association. A considerable proportion of the soil in this area is not altogether typical of the soil as mapped farther south in the state, where the distribution of the Dekalb, the Upshur, and the intermediate soil is more nearly equal. There are many places in the present area where the Dekalb silt loam and silty clay loam predominate over both the Upshur and the intermediate soil; in fact, it was difficult at times to decide whether to map the soil as Meigs clay loam or as Dekalb silt loam or silty clay loam including some patches of Upshur not differentiated on account of their small extent.

The Dekalb material is prevailingly a silt loam to silty clay loam, about 4 to 8 inches deep, the immediate surface being generally decidedly silty. The color is light brown to grayish brown, grading with depth into a light yellow. The subsoil ranges from a brownish-yellow, moderately compact silt loam to silty clay loam, grading frequently into silty clay at about 15 to 20 inches, the texture persisting usually to the underlying parent rocks. On steep slopes where erosion is active the clay

subsoil is often nearer the surface and in places is even exposed.

The frequent patches of Upshur soil have the characteristic Indian-red color of the series. They occur on the slopes, crests of ridges, and tops of hills over the red shales from which the soil is derived. The Upshur soil consists largely of Indian-red silty clay loam or clay, underlain by stiff, plastic Indian-red clay, having usually a greasy feel. These areas would be classed mainly as the Upshur clay type if they had been large enough or of sufficiently regular shape to map.

Spots are found on slopes where the wash or soil creep from the Dekalb soils above has covered the red clay, thus giving rise to a grayish or light-brown soil with a red clay subsoil—a Dekalb-Upshur type. Along boundaries between the yellow and red or where the shale beds are not thick and prominent the color is reddish yellow or the yellow is mottled with red. In this area the Meigs clay loam is not so typical as it is in the counties mapped to the south because the red materials are not so abundant, although there is still enough of the characteristics of the Meigs clay loam to give the land this classification.

The depth of the soil and subsoil varies considerably, depending upon the position of the areas. On the steep slopes erosion has prevented the accumulation of much soil material over the rock, the strata being exposed in places, or at least very near the surface. Usually the depth to the bedrock is 20 inches or more, and frequently is not encountered within several feet of the surface. Throughout the soil mass and upon the surface occur more or less decomposed fragments of shale and sandstone, though rarely in sufficient quantity to interfere with cultivation.

The Meigs clay loam is one of the extensive soil types of the area. It occurs in almost uninterrupted bodies in western Marion and Monongalia Counties. East of this unbroken belt small areas are scattered through the other soil types in central Marion and Monongalia and in western Taylor Counties. These areas cover the sharp crests of ridges and the hilltops.

The type is characterized by broken to hilly topography,

the surface as a whole being rougher than any other soil type except the Rough stony land. The tops of the ridges are generally narrow and irregular, and the slopes as a rule descend steeply to narrow V-shaped valleys. The elevation of the ridge tops ranges from 300 to 500 feet above the valley floors. A feature of the hillsides is the presence of narrow benches or terraces, caused by massive sandstone beds that have resisted weathering and prevented the formation of uniform slopes. On these benches the soil is generally deeper, more loamy and productive than on the slopes and tops. Over the greater part of the type the slopes are so steep as to make their cultivation difficult. The run-off is rapid, and where not protected by a covering of sod or other vegetation the soil material is washed away, forming erosion gullies. There is little opportunity for the storage of moisture and the type is more or less droughty, crops suffering in ordinary dry spells, except in favored locations. Small springs or seepage places occur in the ravines, but these fail in times of drought, and the small runs fed by them usually go entirely dry also. Even the larger streams have very little flow or cease entirely except for the seepage waters passing from pool to pool through their gravels.

The Meigs clay loam is of residual origin, and derived from a variety of sedimentary rocks of Upper-Carboniferous age. The Dunkard formation gives rise to most of this type, although the upper Monongahela formation enters to some extent, especially in the eastern section of the area. These formations consist of a series of interbedded shales, sandstones, and some thin or shaly limestone, coal seams, and accompanying fire clays. Some of the sandstones are fine and some coarse, some massive, and some thin bedded and shaly. The shales also vary from thin to thick bedded and from argillaceous to sandy. Gray shales and sandstones and the red shales give rise to most of the material forming this type.

Although the Meigs clay loam is steeply broken, the greater part of it is cleared and has been under cultivation for some time. The object in clearing this land has been to furnish pasturage, as it is fairly good for grasses. Bluegrass does well on most of it, although rather short lived, except upon phases

of soil particularly adapted to its growth. North and east slopes are much the better pasture land and are also better for the cultivated crops. Southern and western slopes, through longer exposure to the sun's rays, dry out more quickly. In changing this land from its natural forested condition to pasture, care must be taken to prevent erosion. When newly cleared the soil is full of roots, which ordinarily hold its sufficiently for a few years, or until the grasses form a protective sod, but it will not do to grow too many intertilled crops before seeding down.

Corn is the first crop grown and in the early days was planted until the yield had decreased, when small grains, with which the grasses were seeded, were sown. Bluegrass holds for a time and then the native wild grasses and broom sedge gradually take possession of the land. To reestablish bluegrass it is necessary to break the fields again, cultivate one or two crops, and then reseed. Commonly the bluegrass comes in naturally following the cultivated grasses that are cut for hay. The red soils occurring on the slopes are best suited to bluegrass, holding sod about as well as the limestone lands. In fact, these red shale beds are more or less calcareous. Very little care is given the pastures beyond the occasional cutting of the weeds and other growths, yet much of the land after long periods, in some cases of more than 50 years, is still producing good pasture, with no sign of deterioration.

Where the pasture sods do not hold well, their life should be prolonged by giving them top dressings of stable manure, or where this is not available applications of lime and phosphoric acid. Where they can be had cheaply, ground limestone and phosphatic rock (floats) may be employed to advantage.

Timothy, redtop, and clover are grown for hay and give good yields. The fields are then pastured, bluegrass coming in as the other grasses die out. Very few of the steeper hillsides are cultivated, but corn does well upon the slopes, especially on new or sod land. The yield ranges from 20 to 75 bushels an acre, without commercial fertilizers, and averages about 35 bushels. The higher yields are obtained on the more

level areas and the lower slopes. It is the practice now to take not more than two crops of corn before seeding down to small grains and grass. Wheat and oats also give fair yields.

Fertilizers are not used on this soil to any extent. They were tried some years ago, with unsatisfactory results, and their use was discontinued. There is a tendency now, however to revert to their use. There is apparently no reason why this soil should not respond to the use of lime and the phosphatic fertilizers.

Parts of the type will produce fruit, apples and peaches doing well. The upper slopes, in the covelike areas with north and east exposures, where the soil is more loamy and better moisture conditions prevail, are good locations for orchards.

The forest growth on the Meigs clay loam consists of oak, chestnut, maple, hickory, and poplar. The poplar was found most abundant on the northern and eastern exposures and gave to these locations the name "poplar land," while the south and west slopes are classed locally as "white oak land." The latter is not so highly valued as the former.

Farm lands of the Meigs clay loam range in price from $10 to $75 an acre, with the oil, gas and coal rights reserved The general average is about $35 an acre. The price has advanced somewhat in recent years.

Dekalb Silt Loam.

The surface soil of the Dekalb silt loam consists of a grayish-brown, smooth, friable to heavy silt loam, becoming pale-yellow in color below the first 3 or 4 inches. The subsoil, encountered at an average depth of 8 inches, consists of a yellow silt loam, usually grading into a silty clay loam and occasionally into a silty clay, somewhat plastic in structure. Where the underlying sandstone beds approach the surface the subsoil, in its upper section, differs very little in texture from the surface soil, but becomes more sandy as the bedrock is approached. The sand particles range from fine to very fine and give a gritty to sandy feel. Where typically developed the type is close and compact in structure, while in the sandy subsoil phase it is more open and friable.

As a rule the type is free from stone fragments, except where it grades into the stony types, such as are developed on the upper or lower slopes, in which case some shale and slabby pieces of sandstone are encountered. The depth of soil is usually more than 3 feet, but occasionally the underlying rock comes within 2 feet of the surface. The average depth is probably between 6 and 10 feet.

The Dekalb silt loam is found in small, irregular bodies scattered throughout areas of the other upland soils. The total area is relatively small. The areas occur on flat tops of hills and ridges and on flat benches or shelves (not stream terraces) on slopes, and have a flat to gently undulating surface. In places this soil extends down gentle slopes, but nowhere does it occur on steep slopes.

The type owes its position to the presence of massive beds of resistant sandstone that have withstood weathering. The soil material was derived from the overlying grayish shales and fine-grained sandstone, and probably also to some extent from the underlying massive sandstone beds.

The high position of the Dekalb silt loam insures good drainage, although the more level areas may need some ditches or tile drains to put them in the best possible condition.

The moisture-holding power of the type is low and as a whole it is inclined to be droughty, especially in areas where the bedrock approaches the surface. In only moderately dry spells crops often suffer from lack of moisture.

All of the type is cleared and under cultivation, being considered a desirable soil because of its smooth and even surface. Most of this land has been under cultivation for a long time and cropped rather exhaustively. It is only a moderately productive soil. The grasses do only fairly well and only light yields of hay are secured under ordinary conditions. Bluegrass does not thrive sufficiently to encourage the use of this soil for grazing. Small grains, with fertilizers, make good yields. Buckwheat does comparatively well and also Irish potatoes, the latter yielding from 50 to 100 bushels. These yields could be increased readily with better methods of culture. Corn gives only moderate crops.

This soil is deficient in organic matter and a system of soil management to supply this important soil constituent should be followed. Stable manure is one of the best fertilizers, adding plant food, supplying organic matter, and improving the tilth and moisture-holding capacity of the soil. The State Experiment Station has found by experiments conducted on this soil that increases in all crops were made with the use of manure, and that better results were secured with manure than with any other fertilizer. Where stable manure is not available green manuring crops, especially the legumes, such as clover and cowpeas, should be employed.

This soil is favorably located in most cases for orchard fruits, particularly apples.

The original native growth consisted of oak and chestnut.

The areas of this soil are so small that rarely is a farm composed entirely of this one type, and while it is not as strong as the soils on the slopes, farms which include some of this type are considered very desirable, particularly for the production of garden vegetables, potatoes and buckwheat. The value of the land varies according to location and accessibility. Ordinarily prices range from $10 to $50 an acre.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silt loam:

Mechanical Analyses of Dekalb Silt Loam.

No.	Locality	Description	Fine gravel, 2 to 1 mm	Coarse sand, 1 to 0.5 mm	Medium sand, 0.5 to 0.25 mm	Fine sand, 0.25 to 0.1 mm	Very fine sand, 0.1 to 0.05 mm	Silt, 0.05 to 0.005 mm	Clay, 0.005 to 0 mm
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct,*
220801	1 mile northeast of Meadland.	Brown silt loam, 0 to 6 inches.	0.8	1.1	0.9	2.7	3.6	70.7	20.5
220802	Subsoil of 220801.	Silt loam to silty clay loam, 6 to 36 inches.	.0	1.0	1.0	2.0	3.7	66.7	25.7
220825	1 mile north of Morgantown.	Brown silt loam, 0 to 9 inches.	1.2	2.2	1.1	2.1	6.7	65.2	21.6
220826	Subsoil of 220825.	Silt loam to silty clay loam, 9 to 36 inches.	.5	1.6	1.0	1.7	5.5	60.6	28.8
220833	1½ miles south east of Fairmont.	Brown silt loam, 0 to 8 inches.	.4	1.9	2.5	5.5	4.0	62.6	22.8
220834	Subsoil of 220833.	Silt loam to silty clay loam, 8 to 36 inches.	.8	1.0	1.5	3.6	4.6	56.3	32.1

Dekalb Silty Clay Loam.

The surface soil of the Dekalb silty clay loam to a depth of 5 to 8 inches consists of a grayish-brown to yellowish-brown silty clay loam, the surface few inches being generally decidedly silty and in places, such as the lower slopes or on rather flat areas, a heavy silt loam. Some patches are considerably heavier than the typical soil, approaching the texture of a silty clay. The soil is usually rather friable and mellow and easily worked. In places both soil and subsoil are quite gritty. The subsoil is a yellow silty clay loam to silty clay, generally friable or brittle and in places becoming quite plastic. Occasionally the lower subsoil is somewhat mottled with various shades of gray and brown, such coloring being due often to the presence of partially decomposed shale fragments. Sometimes the subsoil has a slight reddish cast. Upon the surface and throughout the soil mass fragments of shale and sandstone, the former partially weathered, are frequently encountered, but not in quantities sufficient to interfere with cultivation. The more stony areas are confined to the steep slopes, where the sandstone ledges are not deeply covered with soil material, while on the smoother slopes, where the shales seem to have predominated, the harder rock is lacking or is represented only by narrow bands of sandy shale or shaly sandstone fragments. A variation not common in this type occurs in central Taylor County and at a few places in Monongalia County, where bands of red soil are encountered on the hill slopes. While these are distinct, they are too small to map separately and have necessarily been included with the type. This phase approaches the condition of the Meigs clay loam, characterized by its patches of red soil, but in the latter there are usually a number of bands or streaks which have influenced the surrounding soils by intermingling with them.

The Dekalb silty clay loam is one of the most extensive soil types in the survey, occurring in all three counties. West of the Monongahela in Marion and Monongalia counties it forms an irregular belt between the Meigs clay loam and the Westmoreland silty clay loam. It occupies the eastern half

of Taylor County, and is well developed in eastern Marion and Monongalia Counties.

The topography is hilly, the soil occurring on the slopes and on the ridge and hilltops as well. West of the Monongahela the Dekalb silty clay loam grades into the Meigs clay loam on the lower slopes of the hills, which are usually gentle and smooth. Generally to the east the formation rises, covering the whole slope and tops of the hills, and the type merges into the Westmoreland silty clay loam on the tops of the high ridges. In this belt the slopes are smooth and steep, although there are sections where the Dekalb silty clay loam covers both the tops and slopes of ridges, and the topography, though hilly, is not quite so broken and is better suited for cultivation In the eastern parts of the area it covers the highest hills from base to summit. The slopes are generally steep, though the ridge tops are often rounded and quite broad. As would be expected from its hilly topography, the type has good surface drainage. The presence of stone throughout the soil mass in most cases further permits some downward movement of water. Seepy places are common on the slopes.

This soil is readily affected by drought, and crops suffer, but not to the extent they do on limestone lands.

The Dekalb silty clay loam is of residual origin and is derived from interbedded shales and sandstones. There are also some limestone beds, but these are thin and have very little effect, if any, upon the soils. The soil material comes from the Upper Monongahela, Lower Dunkard, Conemaugh, and Allegheny formations. The weathering of these rocks is not complete, as their fragments are found upon the surface and in the soil mass. Generally the depth of soil material exceeds 3 feet, but in places ledges approach the surface or outcrop.

This soil generally is friable and mellow and readily works into a good condition of tilth. The steep hillsides are difficult to cultivate and where worked are subject to damage by washing.

The greater part of the Dekalb silty clay loam is cleared and devoted to cultivated crops and to grass. Like all the up-

lands, the larger part is in grass, but as a whole it is not as strong grass land as the Meigs clay loam or Westmoreland silty clay loam. It does not seed naturally with bluegrass nor hold a bluegress sod as do the two last-mentioned soils. Bluegrass persists for a while, but soon gives place to the native wild grasses. Broom sedge soon takes possession of most of the old fields.

Timothy and redtop are the principal grasses sown. They give moderate yields of hay. Clover is also sown to some extent, and where the soil is limed succeeds. Corn gives fair average yields and so do wheat and oats. Buckwheat does well on this soil, especially in the eastern section of the area, from 10 to 20 bushels per acre being secured. Irish potatoes do fairly well. Apples, while not grown on a commercial scale, are grown to some extent, and apparently give satisfactory results. Where the location is favorable, this soil should prove suited to commercial apple and peach orchards.

Commercial fertilizers are used on all crops on the Dekalb silty clay loam. The land is generally considered thin and the use of fertilizers necessary. The quantities used are small, and the fertilizer is generally of low grade. From 100 to 200 pounds to the acre are used. Barnyard manure gives better results than fertilizers. Quite a numbers of farmers apply lime and, as a rule, find it beneficial. The greatest need of this soil is the incorporation of organic matter to improve its moisture-holding capacity and to add humus and nitrogen. When barnyard manure can not be had green manuring crops should be turned under, preferably legumes, such as clover or cowpeas. Winter cover crops like rye and barley should be used when the land is cultivated, and plowed under in the spring to furnish organic matter.

The pastures should be reseeded often and treated with applications of fertilizers. Finely ground limestone and floats (phosphate rock) would help to improve the stand of grass even where the sod is not broken. The native forest growth consists mainly of oak and chestnut.

The value of the farms of this type of soil ranges from $10 to $50 an acre.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Dekalb silty clay loam:

Mechanical analyses of Dekalb silty clay loam.

No	Locality	Description	Fine gravel, 2 to 1 mm	Coarse sand, 1 to 0.5 mm	Medium sand, 0.5 to 0.25 mm	Fine sand, 0.25 to 0.1 mm	Very fine sand, 0.1 to 0.05 mm	Silt, 0.05 to 0.005 mm	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct,*
220805	2 miles north-west of Grafton.	Brown silty clay loam, 0 to 7 inches..	1.4	3.0	1.2	2.1	4.9	53.1	34.4
220806	Subsoil of 220805.	Yellow silty clay, 7 to 36 inches.	1.4	2.3	1.7	2.9	4.1	51.7	36.0
220809	One and one-half miles southeast of Opekiska.	Brown silty clay loam, 0 to 6 inches.	1.8	1.6	.9	2.2	4.4	58.0	31.1
220810	Subsoil of 220809.	Silty clay loam to silty clay, 6 to 36 inches.	1.8	3.2	2.0	3.7	5.1	56.1	28.6
220831	One-half mile west of Fairmont.	Brown silty clay loam, 0 to 8 inches.	2.8	5.8	4.6	6.1	8.3	50.8	21.5
220832	Subsoil of 220831.	Silty clay loam to silty clay, 8 to 36 inches.	1.8	2.5	1.8	3.1	7.6	47.8	35.4

Dekalb Stony Loam.

The Dekalb stony loam, as typically developed, consists to a depth of 5 to 8 inches of a light or grayish-brown silty loam to silty clay loam, friable and mellow. The subsoil is a uniform yellow silt loam to silty clay, containing a sufficient content of sand to make it friable, and extending to a depth of 3 feet or more. Areas of light medium sandy loam too small to be shown on a map of the scale used in this survey are frequently found included in the type.. The subsoil is occasionally tinged with red and in places the underlying sandstone bedrock closely approaches the surface.

Sandstone and shale fragments are found upon the surface and throughout the soil mass, usually in quantities sufficient to be conspicuous and to interfere more or less with cultivation. The soil itself is easily tilled, aside from the inconvenience resulting from these rock fragments. Physically the soil is typical of the established type, except that there are

on the average not so many stone fragments as in most other areas.

The Dekalb stony loam is quite extensively developed in eastern Monongalia County, where it occurs in comparatively large but irregular-shaped areas. A few small tracts are found in eastern Marion and Taylor Counties. The type is principally developed on slopes. In places it extends over the top of Chestnut Ridge. The slopes, as a rule, are long and smooth, and while rather steep are not so pronounced as the slopes of the hills of the other upland soil types. The tops where it occurs are broad and domelike. The type merges into the Rough stony land areas and to the south and west into the Dekalb silty clay loam. The small areas in Taylor and Marion Counties are found in the bowlike depressions where streams head, the development of these stony areas being due to the presence of the talus from sandstone ledges near the tops of the ridges.

The sloping surface of the type admits of ready surface drainage and the presence of stone in the soil mass allows free downward percolation of water, so that fairly good conditions of moisture are maintained at all times, and except in places where the soil is shallow it is not subject to drought.

The Dekalb stony loam is of residual origin and is derived from interbedded shales and sandstones belonging to the Lower Conemaugh and Allegheny formations. A number of sandstone strata occur in the formations contributing to the soil material and where these are present broken rock is found on the surface and throughout the soil mass. The Homewood sandstone of the Pottsville also enters to some extent into the formation of this soil type.

The greater part of the soil is cleared and under cultivation. Although it is not considered a strong soil, fair crops are generally assured in most seasons, as it is not affected so severely by extremes of moisture. The type averages somewhat higher as an agricultural soil in this area than in other sections of the state so far surveyed. Commercial fertilizers are used with the different crops, applications ranging from 100 to 200 pounds per acre. Corn yields from 15 to 50 bushels or more to the acre. The small grains make rather low yields.

Buckwheat, however, does especially well and is grown on almost every farm. Yields of this grain range from 10 to 35 bushels an acre, with 15 to 20 bushels a fair average. Potatoes and garden vegetables do well on this soil. Grass holds only fairly well and the hay yield is below the average. Timothy and redtop are sown with some clover and the pastures later run to native wild grasses, except bluegrass, which does not spread naturally on this soil. In favorable locations this soil should be well adapted to fruit growing. Apples, peaches, and plums would undoubtedly prove profitable.

The native tree growth is composed largely of oak and chestnut. The value of land composed of this type of soil ranges from $20 to $25 an acre, according to location and improvements.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical Analyses of Dekalb Stony Loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220829	6 miles southeast of Morgantown.	Brown stony silty loam, 0 to 6 inches.	1.1	1.9	1.8	5.0	7.5	55.7	26.9
220830	Subsoil of 220829.	Silty clay loam, 6 to 30 inches.	.7	2.2	1.8	4.4	7.8	55.8	27.3

Westmoreland Silty Clay Loam.

The Westmoreland silty clay loam consists of 4 to 10 inches of a grayish to light-brown silty clay loam, grading into a yellowish brown with depth. The surface few inches are decidedly silty. The subsoil consists of a yellowish to brownish-yellow silty clay loam, grading quickly into a silty clay, the latter being generally somewhat plastic. On the gentle lower slopes and more level situations the texture at times approaches a silt loam. The color of this soil is frequently a dark chocolate brown, though over the limestone strata from which

this soil is in part derived the surface soil is a gray to yellowish heavy clay loam to clay, underlain by a stiff, plastic, yellow clay, occasionally mottled with gray or olive green. The depth generally exceeds 36 inches, except where the underlying rock approaches more closely to the surface.

The Westmoreland silty clay loam constitutes what is known locally as "limestone land," and is found in all three of the counties embraced in this survey. It is not derived from limestone exclusively, but rather from interbedded limestone and shales—some of which are calcareous—and some sandstone, the last-named being inconspicuous. The soil material derived from these rocks has intermingled in many places in such a way as to give rise to a fairly uniform soil type, although some patches of Dekalb silty clay loam and some spots of pure limestone soil have been included. Weathering has been complete, and, except on the tops of hills and ridges, the areas are for the most part free of rock fragments.

These pure limestone soil areas are confined to small spots on slopes over limestone ledges, or where the limestone strata are present near the surface. Had they been more extensive, they would have been separated and mapped as a separate type, Brooke clay loam, locally known as "ridge limestone land."

The rocks giving the Westmoreland silty clay loam belong to the Monongahela and Conemaugh formations. The upper limit in the Monongahela is the Uniontown limestone, which is about 270 feet above the Pittsburgh coal. Between the limestone and the coal are several important limestone formations. Below the Pittsburgh coal the limestones, as a rule, are not so prominent, but occur in several beds, mostly thin and unimportant. The lower limit is usually the Clarksburg limestone, 165 feet below the Pittsburgh coal, but in places the limestone soil extended to the Buffalo sandstone in the lower Conemaugh. East of the Monongahela in Marion and Monongalia the limestones were not persistent, being supplanted by sandstones, so that in places no limestone soils were found associated below or immediately above the Pittsburgh coal.

The Westmoreland silty clay loam is found throughout the area. In Marion and Monongalia Counties it follows the course of the Monongahela River and in Taylor County it occurs in the western part along the Harrison County line, broadening out to the south along the Barbour County border. Like the other main upland soil types, it occupies hilly topography, although usually somewhat smoother than the average. The hill or ridge tops are generally rounded, with long, smooth slopes. Occasionally the slopes are broken by benches formed by the more resistant beds of limestones. Such spots are marked by the stronger growth and by the bright green color of the grass. The surface configuration provides ready surface drainage. The type suffers from erosion, gullies being found where care is not taken to check the rapid run-off of storm waters. Small, bare, eroded spots on the hill slopes are very common.

The calcareous nature of the Westmoreland silty clay loam makes it an especially desirable soil for bluegress, consequently it is more profitable for grazing purposes than for the production of cultivated crops. Bluegrass takes possession of the land naturally and the sod is practically permanent. From 3 to 5 acres is enough to support a 3-year-old steer. Whenever the fields are cultivated and are returned to grass timothy, redtop, and clover are sown. Sometimes orchard grass is substituted. These are cut for hay for a number of seasons and in the meantime bluegrass comes in and finally the field is turned over to permanent pasture. The yield of hay is the highest secured on any of the upland soils. Orchard grass does well, especially on the lower slopes or where moist conditions prevail. Very little of this soil is devoted to cultivated crops, but such areas give good yields. Corn ranges from 35 to 75 bushels to the acre and the small grains yield correspondingly well. The crops are grown without fertilizers, though some farmers are beginning to make small applications. Lime is used by some and is always followed by beneficial results.

Practically all the land of this type is cleared. The original growth consisted of the deciduous hardwoods. The locust

is partial to this soil and is seen in small groves on the hillsides and along the fence rows. The growing of this tree for fence posts would no doubt prove a profitable venture. Farms on this soil have a generally prosperous appearance, the houses and outbuildings being large and in good repair. Large barns are quite common, which is not the rule for the area as a whole.

The land, aside from the valuable coal beds underlying most of it, has a high value. It is not on the market, but is held at prices ranging from $50 to $100 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Westmoreland silty clay loam:

Mechanical Analyses of Westmoreland Silty Clay Loam.

No	Locality	Description	Fine gravel, 2 to 1 mm	Coarse sand, 1 to 0.5 mm	Medium sand, 0.5 t 0.25 mm	Fine sand, 0.25 to 0.1 mm	Very fine sand, 0.1 to 0.05 mm	Silt, 0.05 to 0.005 mm	Clay 0.005 to 0 mm
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct,*
220807	1¼ miles north of Simpson.	Silty clay loam, 0 to 7 inches.	1.0	1.8	1.3	3.1	3.4	43.2	46.2
220808	Subsoil of 220807.	Yellow silty clay, 7 to 36 inches.	.4	.9	1.1	2.2	1.0	41.0	53.3
220811	5 miles south of Fairmont.	Silty clay loam, 0 to 7 inches.	1.3	1.3	1.0	1.9	3.7	59.7	31.0
220812	Subsoil of 220811.	Yellow silty clay, 7 to 36 inches.	.8	1.8	1.4	3.0	2.9	47.4	42.9
220821	1 mile north of Vanvoorhis.	Silty clay loam, 0 to 8 inches.	.8	1.2	.8	1.5	3.7	65.6	26.4
220822	Subsoil of 220821.	Silty clay loam to silty clay, 8 to 36 inches.	.4	1.2	.9	1.5	4.9	60.6	30.3

Rough Stony Land.

Rough stony land includes areas too steep and stony to cultivate and naturally unsuited to agriculture. It is limited to the steep hillsides and mountainous areas. The type owes its existence to massive beds of sandstone which outcrop usually near the tops of hillsides, forming precipitous cliffs below which the talus gives rise to exceedingly stony slopes, broken by large bowlders, and unsuited to cultivation. These occurrences are found along the streams and are indicated on

the map by appropriate symbols. In northeastern Monongalia County Rough stony land is frequently found on the broad, smooth tops of the ridges, together with rock outcrops, remains of former rock beds and large angular bowlders, some of them the size of a small house.

Areas of Rough stony land are scattered throughout the three counties, but occur more frequently and in larger areas in the eastern sections, where the sandstone formations are more in evidence. The smaller areas are found along abrupt slopes to streams and the larger along the Monongalia and Preston County line. The Cheat River and Deckers Creek gorges are so steep and stony that they are almost impassable. The type is found in all of the geological formations outcropping in the county, including the Upper and Lower Carboniferous. The Allegheny and Pottsville series are most prominent in its formation, as they are largely composed of massive strata of sandstone. The Pottsville forms the top and upper slopes of the mountainous ridge in northeast Monongalia, while the strata below are found in the Cheat River and Deckers Creek gorges.

The term Rough stony land as used in the soil classification denotes a condition rather than a soil type. Except upon the bare rock outcroppings, some soil is found between the stones and bowlders and is of variable texture, but similar to that occurring on the same slope where agriculture can be carried on.

Rough stony land areas support a growth of oak, chestnut, and various other trees and shrubs. In the gorges and steep ravines in the eastern part of the area the mountain laurel and hemlock are characteristic of the type. This class of land should be allowed to remain forested. Cleared areas, which are few, are used as permanent pastures. Aside from its forest growth and its slight value as pasture, the Rough stony land is practically worthless.

Elk Silt Loam.

The Elk silt loam consists of 6 to 10 inches of light-brown to yellowish-brown silt loam, generally friable and mellow,

underlain ordinarily by a yellow, friable silt loam to silty clay loam, becoming more sandy at depths ranging from 24 to 30 inches. In some situations, such as next to upland slopes, where the material may be in part residual or alluvial, the subsoil is somewhat heavier, changing from a silty clay loam to silty clay of a slightly plastic structure. The material as a rule is friable, but becomes quite sticky when wet. Another variation is found near Fairmont, where the soil is slightly sandy in small spots and underlain by beds of bright yellow to reddish-yellow sand. These deposits have been opened and the sand used for building purposes.

The type is generally free from stone and gravel, though occasionally where shale ledges come near the surface there are some fragments of this rock in the soil mass. In other places also, as shown by exposures on sides of ravines, the soil mantle overlies either sandstone or limestone beds, but these are usually more than 3 feet beneath the surface. As a whole the depth of the soil formation is several feet.

The Elk silt loam is the most extensive of the transported soils. It is confined principally to the Monongahela River Valley, although some areas are found along the tributary streams near their confluence with the Monongahela. The largest areas are in the bends of the river and in the vicinity of Fairmont, where the Tygart and West Fork Rivers come together. The areas are not continuous, occurring on each side of the stream as the channel meanders from side to side.

The Elk silt loam is a stream terrace soil. Although the surface was orginally flat, much of the type has been dissected in varying degrees by erosion, some areas being now gently rolling. The terraces drop off to the first bottoms, either through slopes or by sharp bluffs. The elevation of the terraces above the stream channels ranges from 40 to 150 feet.

The Elk silt loam is derived from old alluvium deposited when the water of the streams reached higher levels.

The type is probably composed of material derived from all the soils of the drainage basin, including considerable limestone soil. It differs in this from the Holston silt loam, which has its origin mainly from wash from shale and sandstone

soils. In places some of the lower subsoil may be residual from the underlying rocks. Near the upland slopes the soil has been influenced to some extent by colluvial material from the adjacent slopes.

Lying as it does, on terraces well above the river, the drainage is well established. The structure is friable and mellow, and the soil, therefore, easy to cultivate. Its proximity to a large stream and the favorable surface configuration caused it to be one of the first to be brought under cultivation. It is practically all occupied at the present time, all the crops of the region being produced upon it, though, as with most soils of this area, a large part is in grass for hay or pasturage. Bluegrass occurs to some extent upon it, but timothy, redtop, and clover are the crops cut for hay, with occasionally some orchard grass. The yield of hay is fair, and the pastures are fairly durable. The small grains, and especially wheat, do well on this soil. Corn is the most important of the cultivated crops, giving fair to good yields. Although only small patches of potatoes are grown, the yields are excellent, and the acreage could profitably be increased. Very little trucking is done in the area. This soil is better than any of the other types for this purpose. It would be adapted to a wide range of vegetable crops, and could support an extensive trucking industry. It would also prove suitable for small fruits, strawberries, and other berries.

This soil responds readily to any good system of management. Its greatest need is the incorporation of organic matter, in which it is now deficient. Barnyard manure is the best for this purpose, but lacking this, the legumes, such as clover, cowpeas, soy beans, and vetches, plowed under, are very satisfactory.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Elk silt loam:

Mechanical Analyses of Elk Silt Loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay 0.005 to 0 mm
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220819	2 miles north of Morgantown.	Brown silt loam, 0 to 8 inches.	0.4	0.9	1.0	2.1	5.4	72.8	17.3
220820	Subsoil of 220819.	Yellow silt loam, 8 to 36 inches.	.0	.3	.4	1.0	3.4	68.5	26.2
220835	1 mile southwest of Fairmont.	Brown silt loam, 0 to 8 inches.	.7	2.0	1.7	3.3	9.7	63.9	18.6
220836	Subsoil of 220835.	Silt loam to silty clay loam, 8 to 36 inches.	1.1	2.2	2.0	4.2	9.1	62.0	19.2

Holston Silt Loam.

The surface soil of the Holston silt loam to a depth of 6 to 10 inches consists of a light to yellowish-brown, friable silt loam. This is underlain by yellow silt loam, usually changing to light silty clay loam, and frequently to silty clay, although in places the subsoil continues downward as a friable silt loam, becoming a little lighter textured or sandy in the lower portions and somewhat compact at depths below 24 inches. In the lower-lying, poorly-drained areas some mottling of gray is found in the subsoil, such areas approaching the characteristics of the Tyler silt loam. The areas along Cheat and Tygart Rivers carry more sand particles, and in places approach a sandy loam texture.

The Holston silt loam is generally free of stone or gravel, except in the areas along Cheat River, where small, rounded gravel and sandstone cobbles are found in the soil mass and on the surface. Small deposits of sand are also encountered.

The type is most extensively developed along Dunkard Creek, in the northern part of Monongalia County, along the Cheat and Tygart Rivers, in Marion and Taylor Counties, and in small areas along the larger creeks. It is found as terraces varying in altitude from 40 to 150 feet above the present levels of the streams. These originally flat terraces have been dissected somewhat by erosion, and are now more or

less gently rolling. Only in a few places has the original flat surface been preserved.

The type owes its origin to water-deposited materials laid down when the streams flowed at higher levels than now. The material was deposited in the same way as that of the Elk silt loam, which type it resembles very closely. It differs from the Elk in that it was washed from regions containing very little limestone soil, being largely derived from shale and sandstone soils.

The Holston silt loam is a type of moderate productivity. It is a well-drained soil, and produces the general crops of this region. It is easily worked, responds readily to good treatment, and is all cleared and devoted to farm crops, a good part of it being in grass for either hay or pasturage. It gives fair yields, especially of corn and potatoes, but is not a strong grass land. It could be advantageously used for small fruits and truck crops.

The greatest need of the type is organic matter. This may be supplied either as stable manure or by turning under green manuring crops. The value of farming lands of this type is high.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical Analyses of Holston Silt Loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay 0.005 to 0 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct,*
220813	6 miles south of Fairmont.	Brown silt loam, 0 to 8 inches.	0.3	1.9	3.4	10.1	8.4	57.4	18.5
220814	Subsoil of 220813.	Silt loam to silty clay loam, 8 to 36 inches.	.0	1.3	2.6	10.0	11.1	51.9	22.6
220817	1½ miles northeast of Mooresville.	Brown silt loam, 0 to 8 inches.	.5	.9	.7	4.5	6.1	67.1	20.0
220818	Subsoil of 220817.	Yellow silt loam, 8 to 36 inches.	.3	1.0	.9	6.1	8.2	62.9	20.5

Tyler Silt Loam.

The Tyler silt loam consists of 8 inches gray to grayish-brown, slightly friable silt loam, underlain to a depth of 24 inches by a pale-yellow to yellow silty clay loam, grading into a silty clay in the lower portion. At 18 to 20 inches mottlings of gray, yellow, drab, and brown appear, the gray becoming more pronounced with depth. The type is free from stone and gravel.

There are only a few small areas of the Tyler silt loam in the area. These occur on Dunkard Creek and to a less extent along several other streams. All the type mapped is found in western Monongalia County, although areas too small to map are encountered in other sections. The type occupies flat to gently sloping terraces along streams and is closely associated with the Holston silt loam. It is derived from the same material as the Holston silt loam, the difference being the result of poor drainage. The average elevation of the type above the stream courses is 40 feet. Its close, compact subsoil is more or less impervious and the areas are generally wet and cold.

Owing to its poorly drained condition the type is best adapted to grass. When drained it gives good crops of the small grains. In moderately dry seasons corn does fairly well, but in wet seasons the crops drown, the impervious subsoil holding the water on the surface.

The extent of this soil is so small that it is of very little importance in this area. With drainage and careful management it can be made a productive type.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical Analyses of Tyler Silt Loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay 0.005 to 0 mm
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220803	3 miles north of Core.	Brown silt loam, 0 to 8 inches.	0.2	0.9	1.6	9.3	7.6	60.6	19.7
220804	Subsoil of 220803.	Silty clay loam to silty clay, 8 to 36 inches.	.0	.3	1.1	7.1	6.4	47.1	37.9

Huntington Silt Loam.

The surface soil of the Huntington silt loam, to an average depth of 10 inches, consists of a brown to chocolate-brown, friable silt loam to silty clay loam. The subsoil is usually lighter colored than the surface soil, owing to a lower organic matter content. It ranges from a light-brown to yellowish-brown or dark-yellow silt loam to silty clay loam, becoming slightly compact at depths below 24 inches and from 24 to 30 inches approaching somewhat a sandy loam in texture. Occasionally a gravelly substratum may be encountered within 36 inches of the surface.

In the eastern part of the area, where the sandstones occur in abundance, the texture in places is a medium to fine sandy loam on the surface, and this material is underlain by sandy loam to a depth greater than 36 inches. Usually, however, there is a silty mantle of varying depth overlying the sandy material. These areas frequently carry some gravel. Along the immediate banks of the streams the material is decidedly sandy. The sandy phases of the type are small and disconnected and but for their small size would have been recognized as a sandy type in the Huntington series. In the main the type is free of gravel or stone fragments on the surface, the exception being near the steep upland slopes where streams break through. The gravel is mostly shale and small pieces of shaly sandstone, with rounded or subangular edges.

The Huntington silt loam is widely distributed outside the territory occupied by the Moshannon silt loam. It occurs as narrow strips in the stream valleys; and while the areas are fairly numerous, the total extent is small. It is found occupying first bottoms along the streams, usually narrow and flat, or gently sloping to the upland levels. As mapped it occurs from barely above the stream level on the smaller branches and runs to as high as the 20-foot contour line along the larger creeks and rivers.

This type is of alluvial origin and is still in process of formation. The material is composed of sediments washed from the upland soils and deposited by the streams on their

flood plains in times of high water. The material comes from many different geological formations, including sandstone, shale, and limestone. The type has been considerably influenced by wash from the Westmoreland silty clay loam, the limestone soil of the area. The type is a fairly well drained soil, though in places small areas could be improved by open ditches. It ranks as a strong, productive soil.

This type is all cleared and under cultivation. A large part of it is in grass. Good yields of hay are secured and the moisture conditions being favorable, the growth of grass is excellent throughout the grazing season. Timothy and clover are the main hay crops. Orchard grass is also sown to some extent and makes a rank, heavy growth, being naturally adapted to a moist soil.

As in most bottom-land types, the small grains make a vigorous growth, but are subject to damage by freshets and have a tendency to lodge.

Corn is the leading cultivated crop on the type. It is particularly well adapted to this crop, and gives yields as high as 100 bushels or more per acre. Corn often receives all the manure made on the farms, as where it occurs the Huntington silt loam is relied upon to produce most of the corn for the farm needs.

In the eastern part of the area, where the sandy subsoil lying close to sandstone is encountered, this type is not considered so good, although it produces fair yields. The higher, well-drained parts produce fair crops of potatoes of good quality.

As most farms are cut by stream valleys, they usually include some bottom land, and the Huntington silt loam is therefore a considerable factor in determining farm values. As the bottom lands are not sold separately, their value can not be stated, although they increase the value of farm holdings according to their extent on individual farms.

The original forest growth consisted of sugar maple, oak, poplar, sycamore, walnut, and butternut.

The following table shows the results of mechanical

analyses of samples of the soil and subsoil of the Huntington silt loam:

Mechanical Analyses of Huntington Silt Loam.

No	Locality	Description	Fine gravel, 2 to 1 mm	Coarse sand, 1 to 0.5 mm	Medium sand, 0.5 to 0.25 mm	Fine sand, 0.25 to 0.1 mm	Very fine sand, 0.1 to 0.05 mm	Silt, 0.05 to 0.005 mm	Clay 0.005 to 0 mm
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
220815	2 miles northwest of Laurel Point.	Brown silt loam, 0 to 12 inches.	0.4	1.0	1.1	4.4	7.9	54.7	30.5
220816	Subsoil of 220815.	Brown silt loam, 12 to 36 inches.	.3	1.3	1.6	9.0	10.9	51.0	25.9
220827	One-half mile northwest of Boothsville.	Brown silt loam, 0 to 10 inches.	.1	.6	1.8	14.0	17.5	39.8	26.0
220828	Subsoil of 220827.	Silt loam, 10 to 36 inches.	.0	.5	1.9	15.0	13.5	44.9	23.7

Moshannon Silt Loam.

The surface soil of the Moshannon silt loam, to an average depth of 10 inches, consists of a dark-brown or dull reddish brown, mellow silt loam to silty clay loam. The subsoil is similar in texture to the soil, but is slightly compact, and at 24 to 30 inches usually becomes somewhat sandy. In color it is a yellowish brown, with a tinge of red. Typical areas of this soil found in the counties west of the area have an Indian-red to reddish-brown soil.

A variation from the type is noticed in the presence of a gravelly substratum occurring either within the soil profile or below it.

At the point of confluence of the small streams with the rivers alluvial fans are formed which in many instances contain considerable quantities of small shale and sandstone fragments; otherwise the type is free of gravel on the surface and in the upper part of the soil section.

The Moshannon silt loam is found in the western part of Marion and Monongalia Counties, occurring in all the stream valleys. The total extent of the type, however, is small. It forms the first bottoms of the creeks and runs and is subject to annual overflow at times of high water. It is associated

with the Meigs clay loam, the residual upland soil derived from the different rock strata of the Dunkard formation. It represents wash or sediments carried down the slopes by the rains and taken up and deposited lower down the stream courses during flood stages. Next the upland slopes the soil material no doubt largely represents accumulations from the adjacent slopes.

The type is an alluvial soil of recent origin. The Meigs clay loam, which, as previously stated, is derived from the Dunkard formation, is characterized by the presence of bands of Indian-red soil on the slopes, where it joins with other soils formed from the gray shales and sandstones. The wash from these red soils has imparted a reddish tinge to the bottom land soils of that particular section and distinguishes them from the Huntington silt loam, which, on account of its different origin, is of a chocolate-brown color.

The streams along which this type occurs are still cutting their channels and no extensive first bottoms occur. Small first bottoms, however, are always present, varying in width from a rod or two on the smaller streams to not over one-eighth of a mile on the larger ones. These bottom are flat or rise gradually to the upland slopes. On the runs they lie 2 or 3 feet above the stream levels, but along the larger streams their elevation is ordinarily from 5 to 10 feet, and never exceeds 20 feet.

The position occupied by the Moshannon silt loam enables it to maintain a good supply of moisture at all times, though it is not wet or poorly drained, except over small local areas forming troughs. In places open ditches are dug to assist drainage.

Like the Huntington silt loam, the type is a strong, productive soil. It is excellent for grass, giving large yields of timothy and clover hay. Orchard grass, because of the good supply of moisture, also makes a heavy growth. This grass is planted to some extent and furnishes excellent pasturage, the growth continuing throughout the summer season, while the grass on the uplands is suffering for want of sufficient moisture. A large part of the type is used for mowing land.

Small grain crops make a rank growth and good yield, but lodge. Corn is the leading cultivated crop. In fact, the bottom lands are depended upon to produce all the corn needed on most farms. The yield ranges from 35 to 100 bushels to the acre. Stable manure is generally applied to this land. Some farmers also use small quantities of commercial fertilizers with the corn, especially when the bottoms have been worked for some time or lie above the ordinary level of overflow. Where flooded, fresh additions of rich sediments are annually deposited.

The value of the bottom lands composed of the Moshannon silt loam is high and largely determines the value of farms where they occur.

Sugar maple, poplar, sycamore, walnut, and butternut formed the larger part of the original forest growths.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Moshannon silt loam:

Mechanical Analyses of Moshannon Silt Loam.

No.	Locality.	Description.	Fine gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay 0.005 to 0 mm
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
220823	3 miles west of Mannington.	Brown silt loam, 0 to 8 inches.	0.2	0.5	0.8	11.0	17.2	45.8	24.7
220824	Subsoil of 220823.	Silt loam, 8 to 36 inches.	.0	.0	1.0	14.6	16.4	45.2	22.7

SUMMARY.

The Morgantown area includes the counties of Marion, Taylor, and Monongalia, situated in the north-central part of the State of West Virginia. It has an area of 560,000 acres, or 875 square miles.

The area consists of an elevated region cut by stream valleys eroded to depths ranging from 300 to 600 feet below the general upland level. The topography is hilly and broken. The altitude ranges from 800 to 2,683 feet above sea level.

The Monongahela River and its tributaries drain the area, the waters flowing north and ultimately finding their way into the Ohio River.

The area is populated by descendants of the early settlers of Scotch-Irish stock and the foreign labor working in the mines. The census of 1910 gives the three counties included in this area a population of 83,682.

The climate is suited to general farming. The mean annual temperature is 53° F. and the mean annual precipitation 41 inches, usually well distributed throughout the year.

Agriculture is in the main confined to the production of the general farm crops and stock raising. Corn, wheat, oats, buckwheat, and potatoes are the principal crops and a relatively large acreage is annually mowed for hay.

The development of the oil and gas resources has taken the labor from the farms by offering higher wages. The income from the rentals and royalties generally exceeds that from the farm, and these, together with the sale of the workable beds of coal, have put most owners in good financial condition.

There are many opportunities for successful agriculture in the region. Stock raising could well be extended by improving the pastures through more frequent reseeding and by using commercial fertilizers. In this way the grazing capacity could be greatly increased. The rougher lands, especially in the western part of the area where sheep do so well, should be devoted to grazing.

Fruit growing, particularly apples, would prove profitable under good management. There are good orchard sites on most farms.

The demands of the local markets warrant the development of the trucking industry. The high terrace soils are well suited to a wide range of trucking crops. There is also opportunity for increased production of dairy products, the demand for them showing a steady growth.

There is much land that should be used for forestry, particularly the steeper slopes, where timber for fence posts could be grown profitably.

Ten soil types, exclusive of Rough stony land, were separated and mapped in the area. These are divided into two classes, according to origin; (1) residual soils, and (2) alluvial soils. The former occupy the uplands and are derived from a variety of shales, sandstones, and limestones of Carboniferous age; the latter have been deposited as stream sediments in the valleys.

The Meigs clay loam is one of the extensive upland soils found in the western and central parts of the area. It is derived from the Dunkard formation of the Upper Carboniferous. It has a steep, broken topography and is used largely for pasturage. It is a good grass soil.

The Westmoreland silty clay loam is the "limestone land" of the region. It is especially valued for its bluegrass pastures and is used almost entirely for grazing cattle.

The Dekalb silty clay loam is an extensive soil type found in the eastern and central parts of the area. It is not a strong grass soil, though used for grazing. It is devoted to the general farm crops.

The Dekalb silt loam occupies the flat tops of hills overlying beds of massive sandstone. It is an easily cultivated soil, but is not strong. Potatoes and buckwheat succeed well upon it.

The Dekalb stony loam is found mostly on the mountain ridges in eastern Monongalia County, occurring on the long, smooth slopes. It produces fine crops of corn, buckwheat, and potatoes.

Rough stony land comprises the cliffs of massive sandstone found on the hillsides, together with talus slopes below. It has no value except for forestry and a little grazing.

The valley or alluvial soils occupy the terraces and bottoms along the streams. The most important type is the Elk silt loam, found along the Monongahela and its tributaries This type is derived in part from wash from limestone soil. Though it is not a strong grass soil, it is easily improved and has a wide crop adaptation. This soil is fairly well located for the production of truck crops to supply the local markets and the mines.

The Holston silt loam occupies the same topographic position as the Elk silt loam, but is not as strong a soil, not being influenced to so great an extent by calcareous soil material.

The Tyler silt loam is of small extent, found usually on second terraces, and is poorly drained. It is a good grass soil.

The first bottoms comprise two types, the Moshannon silt loam and the Huntington silt loam. The former is found in the western part of the area and is of reddish color, being influenced by wash from the red shale soil levels occurring in the Meigs clay loam. The latter is the brownish colored soil found elsewhere in the area, and is also influenced to some extent by wash from the limestone land areas. Both these soils are strong and productive and are important factors in the agriculture. Though the areas occupied by them are small, they are widely distributed and occur on practically every farm.

APPENDIX.

LEVELS ABOVE MEAN TIDE.

Main Line of the Baltimore and Ohio Railroad.

Distance from Grafton Miles	Station	County	Elevation Above Tide Feet
11.7	Independence	Preston	1165.86
10.2	Hardman	Preston	1116.02
8.8	Irontown	Taylor	1078.77
5.7	Thornton	Taylor	1042.99
2.9	Lesmalinston	Taylor	1029.28
0.0	GRAFTON (old station)	Taylor	999.85
1.1	Fetterman	Taylor	990.14
5.9	Coffman	Taylor	984.20
7.7	Valley Falls	Marion	974.16
9.7	Hammond	Marion	941.49
10.6	Powell	Marion	906.61
14.2	Colfax	Marion	890.70
17.3	Benton Ferry	Marion	889.03
20.6	Gaston Junction	Marion	885.46
21.8	FAIRMONT	Marion	882.66
23.3	WD Tower	Marion	876.70
24.2	Barnestown	Marion	876.55
27.2	Barrackville	Marion	905.89
32.6	Underwood	Marion	935.53
36.4	Downs	Marion	962.98
39.7	Mannington	Marion	973.61
43.9	Metz	Marion	1001.96
46.8	Glover Gap	Marion	1040.39
51.0	Burton	Wetzel	1065.55
53.5	Hundred	Wetzel	1017.50

Grafton and Parkersburg Branch of the B. & O. Railroad.

Distance from Grafton Miles	Station	County	Elevation Above Tide Feet
0.0	GRAFTON (old station)	Taylor	999.85
1.4	Woodford	Taylor	999.8
3.4	Webster	Taylor	1018.0
5.7	Bryden	Taylor	1110.0
7.6	Simpson	Taylor	1099.0
9.7	Flemington	Taylor	1027.0
11.6	Rosemont	Taylor	1003.0
17.2	Bridgeport	Harrison	984.0
22.2	CLARKSBURG	Harrison	1008.7

Grafton and Belington Branch of the B. & O. Railroad.

Distance from Grafton Miles	Station	County	Elevation Above Tide Feet
0.0	GRAFTON	Taylor	999.85
5.4	Stonehouse	Taylor	1001.5
6.9	Cecil	Taylor	1011.0
8.8	Sandy	Barbour	1035.6
41.3	Belington	Barbour	1701.6

Monongahela River Branch of the B. & O. Railroad.

Distance from Fairmont Miles	Station	County	Elevation Above Tide Feet
0.0	FAIRMONT	Marion	882.66
1.2	Gaston Junction	Marion	885.46
2.0	Watson	Marion	884.91
2.0	Gaston Mine	Marion	882.84
3.5	Norway	Marion	889.87
5.9	Monongah	Marion	890.63
7.4	Pennois	Marion	894.0
7.9	Everson	Marion	890.66
8.7	Highland	Marion	891.14
10.0	Chiefton	Marion	894.96
11.1	Worthington	Marion	895.51
11.9	Hutchinson	Marion	903.22
13.3	Enterprise	Harrison	909.91
32.1	CLARKSBURG	Harrison	1008.72

Fairmont, Morgantown and Pittsburgh Branch of the B. & O. Railroad.

Distance from Fairmont Miles	Station	County	Elevation Above Tide Feet
0.0	FAIRMONT	Marion	882.66
1.7	F., M. & P. Junction	Marion	876.92
2.4	Hoult	Marion	881.90
4.1	Rivesville	Marion	880.0
4.9	Montana	Marion	877.50
6.8	Catawba	Marion	873.90
8.9	Murray	Marion	870.50
10.7	Opekiska	Monongalia	877.70
13.1	Beechwood	Monongalia	862.00
16.5	Little Falls	Monongalia	849.90
19.0	Round Bottom	Monongalia	842.60
21.7	Uffington	Monongalia	829.20
24.8	Russell Siding	Monongalia	820.00
26.1	MORGANTOWN	Monongalia	822.06
27.1	Seneca	Monongalia	829.50
28.9	Star City	Monongalia	824.05
....	Van Voorhis	Monongalia	818.05
....	Hoard	Monongalia	816.05
38.1	Point Marion	Fayette, Pa.	819.05

Morgantown & Kingwood Railroad.

Distance from Morgantown Miles	Station	County	Elevation Above Tide Feet
0.0	MORGANTOWN	Monongalia ..	824.0
0.7	Siding	Monongalia ..	831.0
0.9	Siding	Monongalia ..	825.2
1.0	Valley Crossing	Monongalia ..	823.8
1.3	Siding (Marilla)	Monongalia ..	833.1
1.5	Siding, Mine No. 5	Monongalia ..	835.0
1.8	Siding (Shops)	Monongalia ..	837.5
1.9	Pool Rocks	Monongalia ..	838.1
2.4	Siding (Glass Plant)	Monongalia ..	849.5
2.5	Sabraton	Monongalia ..	852.7
2.5	Siding (Glass & Steel Plate)	Monongalia ..	853.4
3.8	Rock Forge & Siding	Monongalia ..	967.5
4.6	Richard	Monongalia ..	1044.0
5.9	Dellslow	Monongalia ..	1174.4
8.8	Switch, Lime & Sand Plant	Monongalia ..	1406.2
9.0	Sturgisson	Monongalia ..	1410.0
9.1	Siding (Lumber Dock)	Monongalia ..	1411.4
9.9	Iron Bridge	Monongalia ..	1450.0
10.0	Siding (Lick Run)	Monongalia ..	1464.5
10.5	Lick Run	Monongalia ..	1481.5
12.5	Cascade (and Siding)	Preston	1682.0
13.5	Masontown (and Siding)	Preston	1683.0
29.6	KINGWOOD	Preston	1666.0

For other elevations, determined by the United States Geological Survey, and arranged by quadrangles, the reader is referred to Bulletin II of the West Virginia Geological Survey.

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